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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

JANUARY 28.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Density of Molten Steel," Paper by B. S. Smith.

JANUARY 30.

Institution of Welding Engineers:—Ordinary meeting at 95, New Street, Birmingham. Paper on "Modern Improvements in Electric Resistance Welding Machines," by C. A. Hadley.

FEBRUARY 4.

The Sir John Cass Metallurgical Society:—Ordinary meeting at Jewry Street, London. "The Value of Metallurgical Research to Foundry Practice," Paper by H. C. Dews.

Institute of British Foundrymen.

JANUARY 25.

Birmingham, Coventry and West Midlands Branch:—Lecture on "Some Interesting Moulding Jobs," by E. Longden.

JANUARY 30.

London Section:—Visit to Messrs. Morris Motors, Limited, Coventry.

FEBRUARY 1.

West Riding of Yorkshire Branch:—Official visit of the President, Mr. Wesley Lambert.

Lancashire Branch:—Annual dinner, whist drive and dance, at the Grand Hotel, Manchester.

British Exports of Ferrous Castings.

In our Annual Review we pointed out that the fight-castings industry had made considerable progress. It is now possible to review the year from the actual statistics available. The actual tonnage exported during 1929 was 20,522 as against 19,682 in 1928. The values were declared at £928,274 and £876,745 respectively. Thus not only have 840 tons more been sent abroad, but an increase of 11s. per ton has been obtained. Increased trade has been done with the Argentine, India and Australia, whilst losses have been registered in South Africa and New Zealand. It is to be noted that in recent years the importance of "Other countries" has been steadily growing, and in the last five years a 40 to 50 per cent. tonnage gain has been recorded.

From the point of view of tonnage exports, the cast-iron pipe trade has done particularly well, and an increase of over 18 per cent. has been recorded, the quantity rising from 114,189 tons in 1928 to 136,107 tons in 1929. Unfortunately the increase in the value has not been of a parallel character, and prices have receded from an average of £11 11s. to £10 13s., or 7.7 per cent. The best market has been the Argentine, which has taken some 24,200 as against 9,600 in 1928. Another large gain (50 per cent.) has been registered in South Africa and in "Other countries." The Straits Settlements has shown a slight gain at 19,900 tons. The heaviest loss was in the Australian market, which in 1928 reached 10,369 tons, and last year only 3,828 tons, whilst Indian requirements dropped from 7,570 to 4,250 tons. Four or five years ago this latter market could be relied upon to take 10,000 tons a year.

Every year there are between 1,000 and 2,000 tons of unmachined iron castings exported. In 1929 the actual amount was 1,603 tons, at an average price of £35 13s. per ton. It would be interesting to know just what type of casting is represented by these figures, because in comparison with steel castings in the rough they make a very good showing. Last year, for instance, we exported 1,504 tons of steel castings valued at £58,934, or £39 3s. per ton; that is, just £3 10s. a ton more than grey cast iron.

Cast hollow-ware just maintained last year's showing, but has lost much ground during the last five years. This really constitutes the only real ground for dissatisfaction, as in the last five years some 2,000 tons or £50,000 worth of business has been lost. In the other sections of the export business the British are making some slight improvement.

Finance and Industry.

If we take a glance at last year's bankruptcies and liquidations among industrial companies, the list will appear strikingly similar to that of promotions in the same class of companies during the previous year. In view of this and of the somewhat spectacular nature of the financial events of the year 1929, some remarks on the subject appear pertinent.

The obvious result of these events has been an enormous loss of money, both directly through liquidations and bankruptcies and indirectly through depreciation of investments. There has been the further result that the faith of the investing public has been badly shaken. If the readiness of the public to find money for hare-brained schemes of entirely unproved worth receives a setback there will be those among us, however, who will not be altogether sorry. That readiness is a cause of some bitterness to concerns in the heavy industries that stand badly in need of capital for legitimate extensions, although they are unable to offer more than a modest return for it. It is too frequently forgotten that if a thing is really good enough, the money can almost certainly be raised without any appeal to the public. Vested interests and existing corporations are not disposed to lose their chance of controlling a probable rival or a possible development. So often, too, the history of these companies follows the same line. Some patent with all its worth yet to prove, as we have said, is proclaimed to the world, and application is made for far more capital than can usually be employed profitably all at once by a new business. This offers a temptation to extravagance, and extravagance leads all too soon and all too often to the bankruptcy court.

Profitable business does not and cannot depend on the facile optimism of a company promoter, but on the application and the genius of a first-class man, and on the slow, steady growth of activity and scope by the process of setting one brick upon another in the building of a sure success.

Another blunder that has been prevalent recently, and that is responsible for its own share of apprehension, is the assumption that amalgamation will result *ipso facto* in economy. This is partly due to the authority of the imperfectly understood term "rationalisation," which is interpreted to mean that the larger the business the greater the efficiency. This, however, is by no means the case. Just as, in a dwelling-house,

XUM

the proportion of space wasted on passages, landings, etc., increases with the size of the house, so the proportion of unproductive expenditure increases with the size of a business, unless that business is drastically remodelled and reorganised. The criterion of business efficiency must be economical production. Nothing else can be relied upon to produce either profit or security. Every new promotion and every new scheme for reorganisation or amalgamation must answer this test.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Coal Dust.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I read with considerable interest the discussion upon my Paper, "Coal Dust and Facings in the Foundry," which I was, unfortunately, unable to give personally owing to illness, but which was delivered in my stead by my son.

With regard to the remarks made by Mr. Oxley, Branch-President, referring to the slide showing the clean casting, I do not think it would have been quite fair had we machined the under or bottom side. It was because I found so little subcutaneous defect on the top side of this casting, especially considering the great disturbance that had been going on in the mould due to excessive coal dust, that it was decided to make a slide and show it. In confirmation of this, the runner was left on the casting, which proves conclusively that it was the top side which was machined. It was quite refreshing to hear Mr. Oxley confess that he also, like many other apprentices, had indulged in some of the old tricks in order to endeavour to improve his castings, and, dare I venture to say, enterprises of this sort must really have been at the bottom of the formation of societies like the Institute.

I am sorry that I cannot give Mr. Goodwin any simple way of determining the amount of coal dust in the floor sand without actual repeated analyses, which, under the conditions, is almost impossible, or at any rate fraught with great delay. This must, therefore, nearly always remain a matter of conjecture and experienced judgment, and at any rate cannot be calculated with sufficient nicety to satisfy all but the most exacting.

With reference to the blow-hole, I did not say that it was unusual to find a blow-hole in the position indicated, but it certainly was unique to be able to take a snap through a mica window at the exact instant that the blow occurred.

With Mr. Presswood's remarks as to the excessive use of coal dust I entirely agree. I am really afraid that in far too many instances the pores of the mould are closed up by coal dust being rammed too hard into the box.

Coal dust is occasionally used in steel foundries, but in a very small way, the reason, I take it, being that so little steel is cast in green sand, in addition to which it has always been found in actual practice that high-silica sand moulds are more effective than those carrying carboniferous material in the casting of steel. May I be allowed to express my thanks to the audience for their courtesy to the actual reader of the Paper.

There is one matter upon which I would like to comment, and that is with reference to the partly-machined casting, a slide of which was shown. It seems to me that this partly-machined casting refutes the prevalent idea that coal dust causes internal defects. With the excessive coal dust used in this particular instance, it might be considered that internally there were many defects, yet we found that, while the outside was particularly rough, the iron was free from defect immediately under the skin.—Yours, etc.,

H. WINTERTON.

Kelvinvale Mills,
Maryhill,
Glasgow, N.W.,
January 15, 1930.

Britain's Oldest Foundry Foreman.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Referring to the article of January 9 bearing the caption of "Britain's Oldest Foundry Foreman," I respectfully submit that my own career will compare favourably with that of Mr. George Davis. The writer, Charles Shardlow, was born December 19, 1850, so that now he has turned 79; from the age of 12 has been continuously engaged in foundry work until now. Starting as an apprentice at the works of the Oldbury Railway Carriage Company, Limited, he remained there up to the age of 26, when he was appointed foreman to a Mr. Charles Duckering, of Waterside Works, Lincoln. I stayed in that situation for eight years and then got an appointment under

MR. C. SHARDLOW.

Messrs. Goddard & Massey, engineers and ironfounders, of Traffic Street, Nottingham, where I had charge of many large and very important engineering contracts. I remained in their employ 14 years. I was then persuaded to take over the Britannia Foundry, St. Peter's Lane, Leicester, and for 27 years worked it, with a variety of ups and downs, until compelled by circumstances beyond control—mainly arising out of strikes and lack of capital—I found it imperative to close down and, despite my age, to seek a situation, which it did not take very long to obtain. Fortunately, one presented itself at the XL Foundry, Clarendon Street, Leicester, and there I have been in daily occupation for the past 3½ years, never having been out of work during the whole of my career. I have occupied all sorts of positions in foundry work. Am an experienced patternmaker, estimator and general representative, and wherever I have been employed have always been able to inspire confidence and give satisfaction. Possibly you may think the foregoing a favourable comparison with your report of the activities of Mr. Davis.—Yours, etc.,

CHARLES SHARDLOW.

2, Elms Road,
Leicester.
January 20, 1930.

Random Shots.

I have just heard a tragic echo of an occasion that in itself was very far from tragic. Everyone who took part in the C.I.R.A. trip to Düsseldorf last September will remember Dr. Schilling, who deputised for the Lord Mayor in performing the city's welcome, complete with speeches and "Rheinwein." It appears that Dr. Schilling was involved in a serious motor accident that took place on December 18 last, and that subsequently both he and one of his companions died. Those who had the opportunity of meeting Dr. Schilling will understand and sympathise in this loss to the activities of a city that has by now a place of its own in several of our hearts. . . . . I had prepared somewhat lighter fare than this for you, but the news has only just reached me. . . .

* * *

Another I.B.F. Branch has succumbed to the deplorable tendencies of modernity, and has no doubt thereby caused fresh shakings of the head to the grey-beards. The Birmingham, Coventry and West Midlands Branch threw open its annual dinner, held last Saturday in Birmingham to the ladies. This growing habit of sharing our pleasures with what our ancestors would have referred to as "The Sex" may spring from any one of numerous causes—but few amongst us would be so ungallant as to regret it!

* * *

The guest of the evening on this occasion was Alderman W. Byng Kenrick, who was Lord Mayor of his city last year and so acted as host to our American visitors during their tour. His presence was particularly appropriate, as he has a long-standing family connection with the foundry trade, through an old-established and well-known firm. Another guest was Mr. James Smith, of South Shields, who was being congratulated on his extremely recent election as President of the National Ironfounding Employers' Federation. The obvious success of the evening must have been cause for considerable satisfaction to the Branch-President, Mr. E. H. Tyson, and if the attendance is to be taken as evidence, the inclusion of ladies was a popular move.

* * *

I dreamt the other night that I was called upon to meet a specification for grey cast iron, with a tensile of 35 tons per sq. in. and an elongation of 5 per cent. After mature consideration I decided to supply a Poumay-melted hypoeutectic semi-steel, properly degasified and desulphurised, in nickel-chromium, vanadium-titanium, heat-treated, Lanz-Perlit mixture. And then I woke. Oh, me! A night indeed!

* * *

Discussing that fruitful topic of adult howlers the other day, a friend pointed out to me that, in spite of the care and interest with which I read a certain detective novel called "The Hammer of Doom"—see "Random Shots" for February 7 and 14 last—I had missed one special gem—namely, that one of the characters, feeling very despondent, sat down on the dashboard of his car! I haven't verified it, so I hope Mr. Francis Everton will forgive me if I'm wrong (or rather, if my informant was). But if it wasn't "The Hammer of Doom" then it was some other book—

MARKSMAN.

High-Duty Cast Irons.*

PRESENT POSITION OF GREY CAST IRON.

By A. E. McRae Smith, M.A.

Grey cast iron has always been looked on as the easy-casting alloy, but to-day it is being criticised by engineers as being an unreliable material, and there is a real danger that it may be superseded for high-duty work by other alloys, and this in spite of the fact that grey cast iron has occupied the attention of engineers and metal founders for a very long period of years. On account of their present great economic position in the world's life and industry, that series of complex alloys which are known as the grey cast irons are only now receiving a small quota of the attention and research which is due to them.

Grey cast iron has rightly been looked upon as the cheapest and simplest of casting alloys, and it is only within the last ten or twenty years that the engineering trades, by reason of their ever-increasing demands for castings capable of withstanding the very severe conditions of service, have shown the real worth of this series of adaptable alloys.

Engineers now call for castings where the main object is not only increased strength and durability under ordinary conditions of moderate temperatures and pressures, but these properties have to be coupled with such characteristics as freedom from growth under extremes of alternate high and low temperatures, perfect soundness under exceedingly high hydraulic and pneumatic pressures, maintenance of strength at high temperatures, resistance to wear under very severe conditions, either lubricated or unlubricated, and, what is most important of all, uniformity of physical properties throughout diverse thicknesses of section and diverse masses of castings.

It is not suggested that metallurgists should not discard any metal or alloy which has been proved to have lost its place in the material world. On the contrary, if one can but take, in the majority of instances, steel castings or fabricated steel structures or aluminium alloys, such as that wonderful series known as the aluminium silicon alloys or the magnesium alloys and substitute them generally and economically in structures which are to-day built up from grey-iron castings, then the author would be the last to sing the praises of grey cast iron.

Again, it is not thought, when looking into the future, that in decades to come, when the nickel-chromium-iron alloys of the stainless steel and stainless nickel types have been so far elaborated as to be able to come into their own, then we shall have an era when all dynamic and static structures will be fabricated from non-corrodible alloys whether they be fashioned from the working of billets into rods and sheets augmented by welding and similar processes or from the direct casting of such alloys into shapes of the most varying complexity.

Yet it must be remembered that in the heavy mechanical trades to-day cast iron still retains the lion's share where irregularly-shaped articles have to be produced to meet high-duty engineering requirements. However, a significant sign of the times is to be seen in the Press reports that the L. & N.E. Railway Company have adopted steel castings for the high-pressure cylinder bodies in their most up-to-date type of locomotive. Foundrymen and metallurgists must ask themselves why this should be, and my answer is that those who are in a large measure responsible for keeping their industry up to date have not realised that they must keep abreast of requirements, and supply engineers with material which will be much better than commonplace cast iron and, what is more important, will be much more suitable, by virtue of its physical properties, than steel castings in the manufacture of pressure-containing and wear-resisting components of modern machinery. In the last few years various avenues of research have resulted in different workers or groups of workers both at home and abroad devoting their time and energy to types of cast iron suitable to satisfy the engineer's desire for castings which will not only be stronger and better but which will be reliable, consistent and homogeneous in character.

Equalised Tensile Strength in All Sections.

It is of little use to the engineer to be told, or even guaranteed, that a certain grade or type of cast iron will give a tensile strength of 12, 16 or 20 tons per sq. in. in a 1-in. section, if that cast iron cannot be relied upon to be reasonably "the same all through," *i.e.*, to show the same or nearly the same resistance to rupture no matter what the section or mass or complexity of the casting may be. When a customer buys a rolled or hammered mild-steel bar of, say, 5 in. or 8 in. diameter to a 28 to 32 tons per sq. in. specification he is quite prepared to expect a drop of perhaps 2 or even 4 tons per sq. in. between the outer and the inner areas of this bar, but unfortunately the buyer of common cast iron to-day may have the unpleasant experience of getting a 50 per cent. or even greater drop in the physical properties of his material when the mass of the section reaches such dimensions.

In the same way with castings, were one to cut up individual grey-iron castings exhibiting widely varying sections and masses, one would find that the buyer of even 11 tons per sq. in. cast iron (as judged by small-section separately-cast test bars) had made a very bad deal, yet this thing is going on in the trade every day, and unless we set our house in order and improve the all-through quality of grey cast iron, it will undoubtedly be ultimately superseded for high-duty work.

Of course, it must be remembered that a great many users of cast iron only require a comparatively weak metal, which, provided it is used in castings of comparatively light section, is readily machinable, and is clean and sound under the skin on all surfaces, will fill the bill, whereas mechanical engineers to-day require castings which will not only be readily machinable in all sections, but which will also be uniformly strong throughout greatly varying masses, give good finish and grain in the heaviest portions as well as the lightest, and, above all, fulfil the required conditions of pressure resistance, and in many cases retention of normal physical properties under very abnormal temperature requirements.

Growing Competition.

But even when dealing with the commoner grades of grey cast iron we must remember that, unless one can combine reliability and strength in light sections with cheapness, then fabricated rolled steel will undoubtedly oust poor-quality grey-iron castings even in this lowly sphere. One has only to refer to the modern tendency to replace cast-iron machinery bed-plates by fabricated steel structures.

In some of the specialised fields, grey cast iron has so far not been seriously opposed, as, for example, in the light castings trade, but here again all light castings are not of equal merit. Such a grade of casting cannot be classed as requiring high-duty irons in the accepted sense of the term; yet even in this line founders should produce a casting made from a perfect casting alloy, which will be strong enough to withstand rough treatment in transit and in service and still be soft enough to allow of any machining and fitting being carried out readily and cheaply, and, finally, in many cases be capable of going through the galvanising, enamelling and similar processes to perfection.

Annual Fire-Bar Wastage Deplorable.

Another important specialised field is the production of heat-resisting cast irons, a field where, in many cases, heat-resisting properties, coupled with soundness and strength, as well as freedom from growth and distortion, are much more important than machinability and the like. In this particular sphere, if one could calculate the waste of money which takes place every year from the use of furnace fire-bars and similar castings made from very cheap, but extremely unsuitable, cast irons, one would be really astounded at the magnitude of the amount of money involved. If only foundrymen would encourage engineers to look closely into this matter and to experiment with heat-resisting types of iron, the castings being supplied by founders on a guaranteed heat-hours basis, then they would have accomplished something worth while for the grey cast-iron cause.

In the writer's opinion, in order to satisfy the requirements and conditions already enumerated, it is essential that those people engaged in the production of grey-iron castings to-day should set out to produce high-duty cast irons which not only aim at being "the same all through," *i.e.*, to say "of equal strength and character throughout a variety of inequal sections," but that these cast irons, in the shape of individual castings, should be produced on such an economic basis that modern grey cast iron will remain supreme as the chieftain of the casting alloys, both ferrous and non-ferrous, for a great many years to come.

Problem of Southern Foundries.

Iron foundries in the south of England are faced with many problems which foundries in Scotland, as well as the North and Midlands of England, do not experience, and these are mainly concerned with the price and choice of raw materials. The writer only intends to deal with high-duty or high-test irons which can be produced directly from the cupola without the aid of refining processes, superheating processes, heat-treatment processes and the like. The Lanz process, however, which uses true cupola-melted metal as its basis, will be included in the present survey. When one sets out to make high-duty irons, it is only natural that the cheapest satisfactory materials are used, and also that these raw materials are converted into satisfactory castings by the cheapest and most efficient methods. Castings for high-pressure duty must be made, not only to a high-test specification, but must also be made from materials and by processes which are as cheap and economical as possible.

Choice of Raw Materials.

The metallic raw materials available for the production of cupola-melted grey cast irons may be classified as follow:—(1) Pig-irons; (2) scrap cast iron recovered from the trade; (3) foundry scrap or surplus melt; (4) steel scrap; and (5) ferro-alloys and alloying elements. Under the heading of pig-irons, the choice is very great, so great, in fact, as to be in some cases quite bewildering. Where reliable metallurgical control is available, all pig-irons should be bought to specification, and each specification should be drawn up with reason and discretion. For instance, in a 1 per cent. silicon pig-iron, the limits should be 0.9 per cent. to 1.1 per cent., but in the case of a 3.5 per cent. silicon iron (unless for special use, such as in electrical castings, where

* Based on a Paper presented to the Sheffield and London Sections of the Institute of British Foundrymen. The author is Metallurgist to Messrs. J. & E. Hill, Ltd., of Dartford.

small variations in silicon may be detrimental to the magnetic and conductive properties of the castings), the limits should be 2.7 to 3.3 per cent. for common work.

Unfortunately, many makers of pig-iron today are very lax in the manner in which they state the analysis of brands of pig-iron, a common feature being the omission of the total carbon content. Never buy pig-iron without having this figure declared, but, on the other hand, do not buy any expensive low-total carbon iron where iron with a higher carbon content will satisfy. Again, do not pay a fancy price for pig-iron high in silicon, *i.e.*, over 4 per cent. silcon, also high in total carbon, for extremely light castings, when it is possible to mix cheap high-silicon, low-total carbon iron, such as high-silicon Northants, with cheap medium-silicon, high-total carbon foundry pig-iron.

Making Light Castings.

In the manufacture of very light castings it is such properties as exactness of form, freedom from obvious defects, and easy machinability which are the determining factors; whether one can produce such castings of equal quality more cheaply in one district or in one country as compared with any other district or country. Consequently, as strength does not enter seriously into the general run of this class of work, the choice of pig-irons is naturally limited to the cheaper grades of moderately high-carbon, high-silicon and phosphoric iron coupled with hematites, and pig-irons of the hematite type. Where light castings have to be enamelled it is the usual practice to adhere to a low-sulphur, low-manganese iron, and this is accomplished by using larger percentages of pig-iron with or without desulphurisation with soda ash for the best grades of this type of casting.

Medium Castings Require Attention.

Intermediately, there is the general-utility medium-strength castings, including machine bedplates and the like, which are usually made from the cheapest phosphoric irons, sometimes, unfortunately, without much regard being paid to the strength of the iron so long as the jobs hold together and are reasonably soft and free from outward defects. This is the class of cast iron which the engineer to-day has in mind when he calculates the strength of grey cast iron at 1.5 tons per sq. in. Later it will be seen that he is perfectly justified in his assumption.

High-Grade Material.

However, in castings which are to be used for the manufacture of such articles as Diesel engines, high-pressure steam-engines, compressing-plant castings, hydraulic machines, and more particularly castings of great mass and diversity of section requiring also high strength and resistance to wear and pressure throughout their entirety, then a different tale can be told. Sufficient evidence of this is the fact that there are now on the market a large number of kinds of refined irons. These refined irons are made by different processes, but many of those manufactured in Britain are simply cupola-melted mixtures—high in steel scrap, low in phosphorus—produced with or without the application of desulphurisation processes and melted under conditions where carbon control is the main feature of the cupola melting-practice.

Other irons of this type also on the market and which are better value if one really requires a refined iron, are the synthetic irons where the refining process consists of pouring molten steel into low-phosphorus molten cast iron in a mixer and transferring the resulting molten alloy to a pig bed.

Double-process irons are also manufactured; these are first cupola- or air-furnace melted and subsequently transferred in the molten condition to an electric furnace, where they are refined by flux additions and carbon oxidation much in the same way as steel is treated.

Such refined irons are very useful and convenient when employed in foundries which are not under direct metallurgical control, but they are very expensive, and such irons can be very easily spoiled during remelting either by undulyhigh carbon pick-up from bad melting conditions or by use in really unsuitable mixtures and classes of work which do not require such irons. Every foundry which has the services of a competent metallurgist or trained foundry manager should make use of the cheapest grades of metallic raw materials which will give the desired results, and it is quite possible to make high-tensile castings from cheap cupola mixtures.

(To be continued.)

Protective Coatings for Iron and Steel.

PREVENTION OF CORROSION.

Before a meeting of the Institution of Mechanical Engineers (North-western Branch) at Manchester on January 9, MR. E. O. JONES, B.Sc., A.R.S.M., read a Paper on "Protective Coatings for Iron and Steel," in the course of which he remarked that the economic loss due to corrosion of iron and steel alone was estimated by Sir R. Hadfield to be of the order of £500,000,000 per annum. The problem of corrosion prevention was therefore one of considerable importance, both to the metallurgist and the engineer.

Corrosion might result from either direct chemical attack or electro-chemical action. Examples of the former were found where metal was in contact with highly reactive media or exposed to high-temperature oxidation, but most examples of industrial corrosion at ordinary temperatures, such as occurred when metal was exposed to atmospheric conditions, was buried in the ground or was in contact with natural waters which were electro-chemical in character. At ordinary temperatures, direct oxidation was so infinitely slow that it could not possibly account for the relatively rapid attack which metals underwent in service.

The electro-chemical theory in its modern form was largely due to Mr. U. R. Evans. The theory showed the various ways in which corrosion currents might arise, it took into account the nature of the metal and the corroding medium. It explained satisfactorily the phenomena of pitting and of passivity and also the apparent anomaly that, although the final corrosion product was an oxidised body, the corrosion was largely concentrated on those areas least accessible to oxygen.

Corrosion may be either general or localised. Where it was distributed over the whole surface the rate of attack would, in most cases, be very slow, and would not constitute a dangerous condition, but where it was localised (and this was the general tendency) the attack was much more rapid and might cause speedy failure. To prevent corrosion entirely was probably impossible but, knowing the cause and mechanism, it should be possible by the exercise of suitable precaution to keep corrosion within reasonable limits and, in particular, prevent its assuming the dangerous localised form.

Three alternative methods (continued the author) are available:—(*a*) the use of special corrosion-resistant alloys, (*b*) preliminary treatment of the water which is causing the trouble and (*c*) preliminary treatment of the metal to provide it with a protective coating. The protective coatings which may be applied to iron and steel are (1) another metal, (2) paints, (3) tarry or bituminous paints, (4) cement or concrete, (5) vitreous enamels, (6) oxide or phosphate films and (7) grease or oil films.

Metal Coatings.

Metal coatings may be applied either by (*a*) hot-dipping, (*b*) electro-plating, (*c*) heating with metallic dust, (*d*) spraying with molten metal or (*e*) mechanical welding. Metal coatings have certain inherent defects. In the first place none of them with the exception of gold and platinum is incorrodible and secondly there is the danger of discontinuities in the coating which may give rise to a corrosion couple causing anodic attack of the more reactive metal. Where this is underlying the steel, the attack may be concentrated on the small exposed areas, and the "protective coating" will have done more harm than good. If the coating is the more reactive, then the steel remains unattacked so long as it functions as the cathode, *i.e.*, it is protected by the "sacrificial corrosion" of the applied coating. The problem is further complicated by the fact that the same metal may function either as an anode or a cathode with respect to steel depending upon the particular conditions. Considerable judgment is therefore required in choosing a protective metal coat and due regard must be paid to the service conditions.

Paints and Varnishes.

Paints and varnishes protect the underlying metal by mechanical action and offer the advantage over metallic coats in that, being non-conductors, there is no electro-chemical action between the coat and any exposed metal. As against this they deteriorate in service and are liable to peeling and flaking, and are therefore much less permanent. In general, four or five applications are necessary in order to provide adequate resistance to moisture penetration, and it is desirable that the priming coat should have an oxidised or basic pigment in order to maintain a passive oxide film on the metal. The functions of the pigment in the finishing coats is mainly to give the requisite strength and toughness to the paint film. Nevertheless, its chemical properties cannot be neglected entirely but must be considered with respect to the atmosphere or liquid to which it is exposed.

Tarry and Bituminous Paints.

Tarry and bituminous paints are more resistant than linseed oil paints and are therefore largely used where the atmosphere is strongly corrosive as in chemical works. They are also used in marine engineering and as a protective coating for pipe lines, their insulating properties rendering them efficient protectors against corrosion due to stray currents. The drawback to their use on the interior surfaces of pipes, owing to the difficulty of obtaining a smooth surface, has been largely overcome by the modern methods of applying by "spinning" and "electro-deposition."

Concrete or Cement.

Concrete or cement has an alkaline reaction and will protect embedded steel or iron, provided care is taken to avoid the presence of chlorides. Care should be taken that any sea sand used has been thoroughly well washed, and the practice, sometimes adopted, of adding salt to the mixing water in cold weather should not be permitted on ferro-concrete work. The protective action of alkaline cement does not extend to lead and zinc, and from what has been said about the avoidance of chlorides it follows that cements of the oxychloride type do not confer protection.

Vitreous Enamels.

Vitreous enamels, oxide and grease films are extremely resistant to corrosive media, but their brittleness and liability to "chip" are serious drawbacks where hard usage is required. Of recent years increased toughness has been attained and enamel ware is finding increasing favour in the chemical industry.

Oxide films, which are produced in the "blueing" and Bower Barf processes, are efficient while intact but, being brittle, cannot be applied to materials which receive subsequent bending. In the costellising process a film of iron-phosphate, which is effective even when very thin, is produced. Such a coat is often used on nuts, bolt, washers, etc., and as an undercoat below the stove-enamelled coat on cycle parts.

Grease films are only used as a temporary protection for metal in storage.

Sand-Mixing Plant at the Rugby Works of the English Electric Co., Ltd.

Our representative recently had an opportunity of inspecting the sand-mixing plant which was installed by August's Muffle Furnaces, Limited, of Thorn Tree Works, Halifax, in the Rugby works of the English Electric Company, Limited. The plant consists of two No. 2 size Simpson Intensive sand mixers with heavy mullers, complete with bucket loaders and August's aerators, knock-out grid, elevators, rotary screen, magnetic separator and storage hopper.

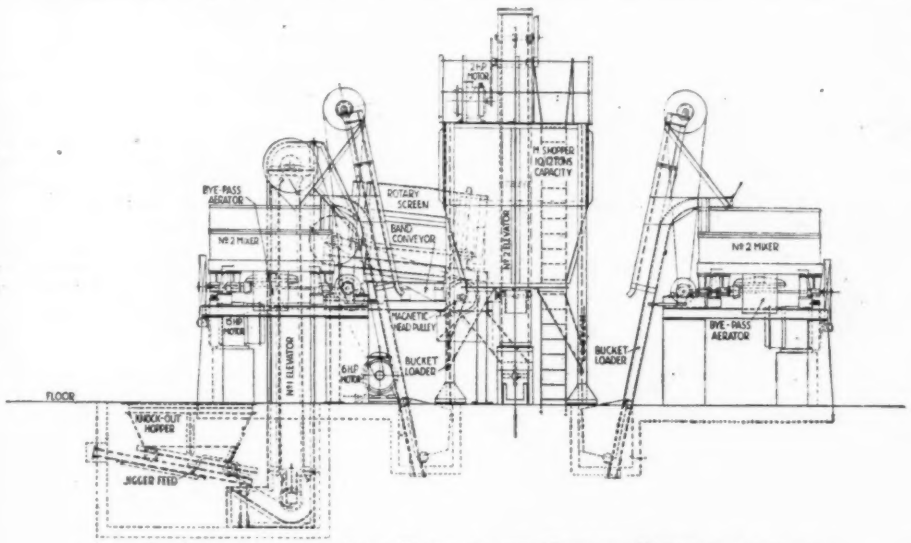

FIG. 1.—LAY-OUT OF THE SAND PLANT OF THE ENGLISH ELECTRIC COMPANY.

The two units are placed side by side and fed from their respective shutes from an elevated storage hopper of approximately 12 tons capacity which is mounted between them.

The plant was originally installed solely for the treatment of facing sand, though naturally provision was made for a throughput capacity well above actual requirements. However, at the time the plant was installed the company was trying out a small sand slinger of the fixed type by the Foundry Plant & Machinery, Limited, of Glasgow. Having proved the possibilities of this machine for the class of castings produced, the machine was made portable by being mounted on a bogie travelling a line of track on either side of which the boxes are assembled. The trolley is travelled manually.

To obtain from the sand slinger the most efficient service, apart from the danger to the men employed from flying pieces of metal, it was determined to treat the whole of the sand, both backing and facing.

Obviously this placed a burden on the sand-mixing plant considerably in excess of its designed output, and it speaks well for the elasticity of the units as regards throughput capacity, as also for the robust nature of their structure, that they are standing up perfectly to the heavy overload which they are constantly called upon to carry. In addition to treating the whole of the sand, loam is also prepared in the mixers; for this last it is merely necessary to change the ploughs.

Cycle of Operations.

The sand is delivered by tippling old sand through a grid in the floor. It is then taken by a jigger feed and delivered into a bucket elevator which feeds a rotary screen, the oversize from this screen is delivered into barrows at floor level, the through material passes over a magnetic separator to feed a bucket elevator which delivers the sand into the overhead storage hopper of 12 tons capacity; this hopper terminates in two shutes to feed the charging buckets for either mixer. Into the buckets, which take a charge of about 9 cwts., new sand is added as required; the buckets are then discharged into the mixer in the usual manner. The time taken for a mix of facing sand is approximately 3 min., and for a mix of loam from 5 to 6 min. The mixers, with their bucket-elevating gear, etc., are each driven by a 15-h.p. English Electric motor. The jigger-feed, the No. 1 elevator and the rotary screen are driven from a 6-h.p. motor, whilst the No. 2 elevator which feeds the storage hopper is independently driven by a 2-h.p. motor.

Our representative was informed by the English Electric Company that the plant has not only been responsible for an increase in output, but has also effected a reduction in working costs.

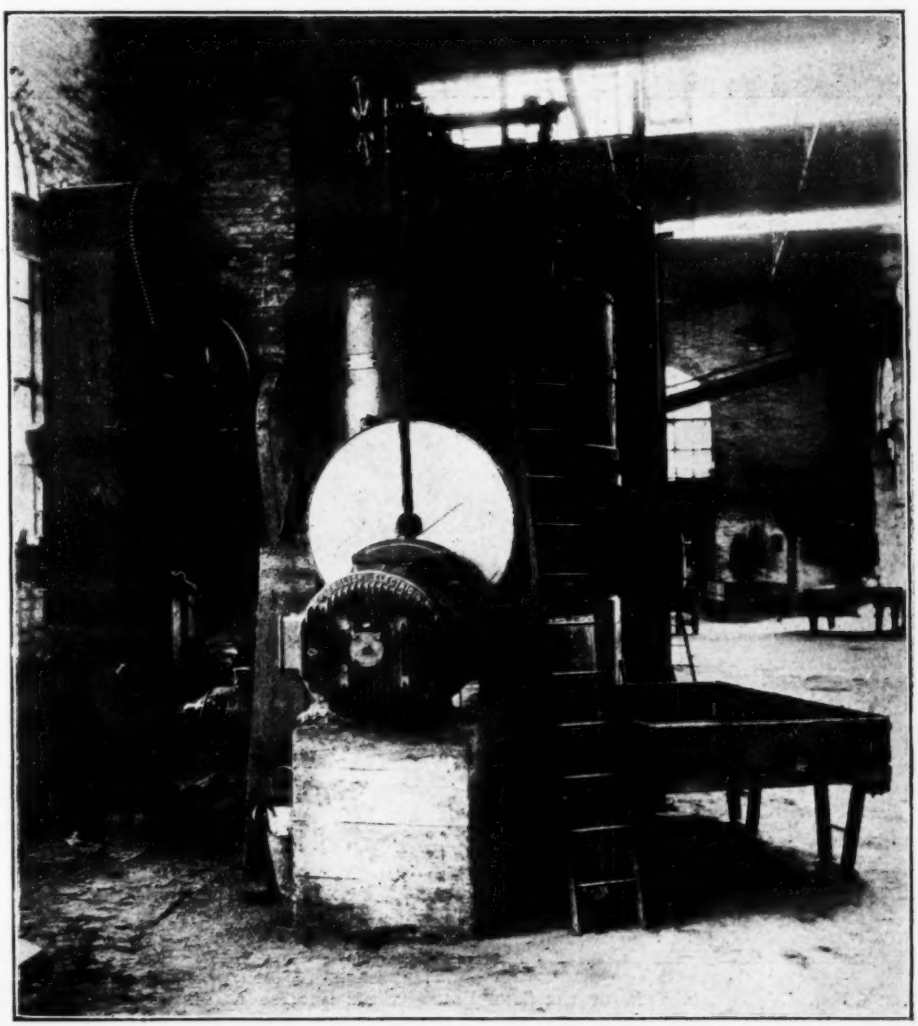

FIG. 2.—SHOWING NO. 1 ELEVATOR, THE POSITION OF WHICH IS SHOWN IN FIG. 1.

Technical Associations and Industrial Metamorphosis.

The New Outlook.

Mr. Wesley Lambert (President of the Institute) and Alderman W. Byng Kenrick, J.P. (Deputy Lord Mayor of Birmingham) were among the guests on Saturday, January 18, at the annual dinner of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen. Mr. E. H. Tyson (Branch-President) was in the chair.

In proposing the toast of the Institute, Alderman Byng Kenrick said that it was only with the passing of the 19th century and its traditions that there began to be established institutions or associations such as theirs with

Sand-Mixing Plant at the Rugby Works of the English Electric Co., Ltd.

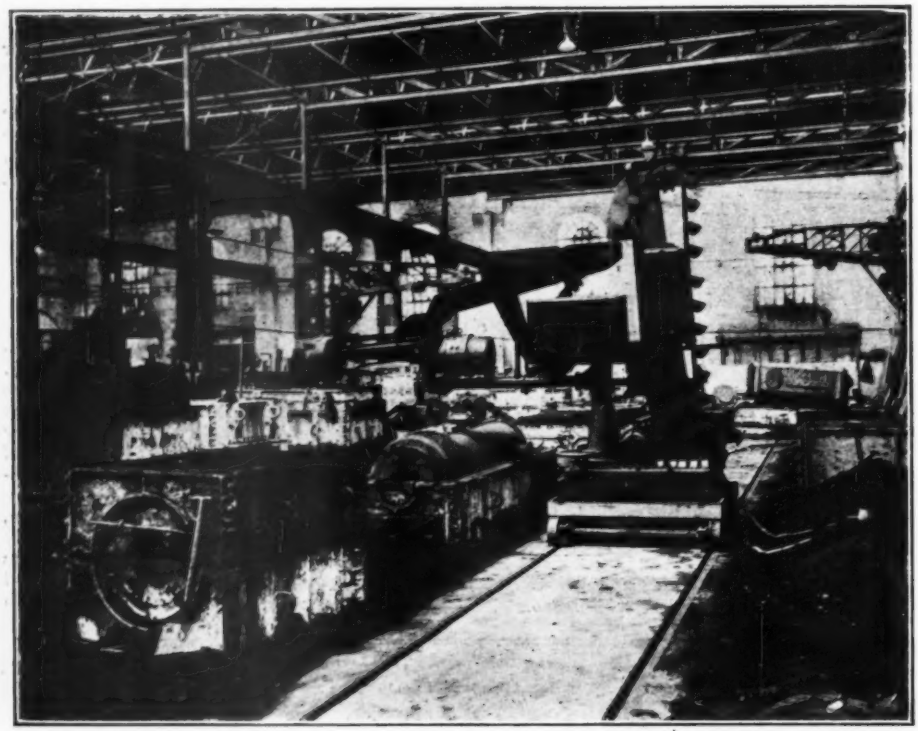

FIG. 3.—VIEW OF SAND SLINGER BAY AT THE ENGLISH ELECTRIC COMPANY.

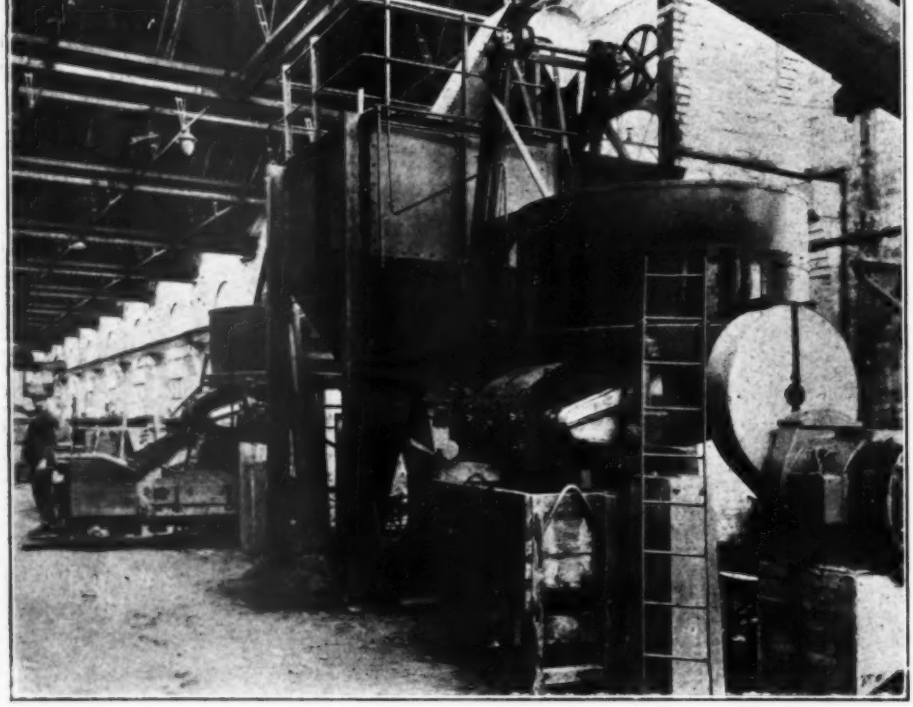

FIG. 4.—GENERAL VIEW OF THE SAND PLANT AT THE ENGLISH ELECTRIC COMPANY.

the idea of doing what their ancestors would have called "swopping trade secrets," a thing which to them would have been inconceivable, and, indeed, would have appeared immoral. It was felt that some good might be done by pooling experiences and discoveries. He congratulated the present generation upon having had such progenitors and upon so well maintaining and developing the tradition that was established at the beginning. The Institute had been of great advantage during a period when conditions in the foundry trade were rapidly changing. In the past quarter of a century there had been great developments both in the varieties of metal used and their combination. Progress would not have been nearly so rapid if those engaged in the industry had not been willing to come together from time to time to compare experiences and to help one another. By their action they had not only benefited themselves, but the nation as a whole. So far as technical equipment, experience, instruction and natural ability went, British foundrymen were equal to any in the world. Though at the moment the manipulators of pressed steel, drop forgings and hot-pressed metal had hit them very hard in the foundry trade, he felt sure that the foundry trade was arranging a "come back." Nowadays, Alderman Kenrick added, business declined to be tied down to particular localities because of their natural resources. Where there was enterprise, financial advantages and a vigorous working-class population industries would be located without regard to the points of the compass, parallels of latitude or anything else.

One Hundred Papers.

Mr. Wesley Lambert, in reply, recalled that the Institute had its birth in Birmingham, and said its aim was the non-political furtherance of the foundry industry and the dissemination of technical knowledge appertaining to the industry. Its membership roll was now somewhere about 2,000. Every endeavour was being made to see that the young foundry worker received education in subjects related to the industry, so that Great Britain might in future, as in the past, uphold the traditions which the craftsmanship of the foundryman so worthily merited. Referring to the syllabus of the branches, Mr. Lambert mentioned that during the current winter's sessions over 100 technical Papers would be presented, a number which, he thought, would not be exceeded, or perhaps even equalled, by any other technical organisation in the country. The Institute was very proud of the Birmingham branch, which included some of the most active members of the Institute.

British Shipbuilding Revival.

In inviting Mr. J. Smith, of South Shields, to propose the toast of the Birmingham, Coventry and West Midlands Branch, the Chairman said Mr. Smith had been elected President of the National Ironfoundry Employers' Federation. He was also President of the North of England Ironfounders' Association and a Past-President of the Newcastle Branch of the Institute.

Mr. Smith, having complimented the Birmingham branch on its work and progress, emphasised the importance of the Papers being practical as well as scientific. It was no use making good materials, he said, to put into bad moulds. If the scientific and the practical sides of the trade worked harmoniously together, there was not the slightest fear for the future of the industry. Mr. Smith commented on the severity of the foreign competition, but pointed out that, though this country could no longer be considered the workshop of the world, the latest shipbuilding returns showed that we still produced 50 per cent. of the total tonnage.

Acknowledging the toast, the Chairman said that, in spite of difficult times, not only had the strength of the Branch been maintained, but there was a slight increase in the membership.

Melting Iron in the Rotatory Furnace.*

By Ch. Bouvard.

Processes of Melting Iron.

To the different methods employed in the foundry for melting iron, there may be added to-day the new method of melting in the rotatory furnace. It can be stated at once that this new process has yielded immediate results so conclusive that it should replace in the near future all other melting methods—the crucible, cupola, reverberatory furnace and the open-hearth furnace.

Primarily designed for the manufacture of American malleable cast iron, this furnace in effect equally allows the melting of cast irons of all classes and qualities, and also appears adapted for manufacturing steel castings. It is proposed to describe here this rather special type of furnace, investigated for several months in a German foundry which, in view of the results obtained, has decided not only to install a second identical furnace now completed, but has definitely put out of commission the open-hearth furnace which it used previously for manufacturing high grade malleable.

It is also proposed to detail the results recorded at this installation in order to show the advantages which this new method offers, and, to this effect, it seems desirable briefly to summarise first of all the different methods currently used.

Crucible furnaces are not used so widely to-day, because the advantages resulting from crucible melting regarding the quality of the metal obtained are far from being compensated by the heavy fuel consumption and maintenance costs.

The open-hearth furnace is an excessively expensive installation, and used only in large foundries. It is also inconvenient to work because of the method of intermittent working which is inherent.

Finally, therefore, one can compare only the cupola and the reverberatory furnace with the rotatory furnace. The cupola, ordinarily used for the melting of engineering castings, serves equally well for making whiteheart malleable, but cannot be used for the American variety, known as *blackheart*. The recent introduction and development of blackheart malleable on the European market has led to the various companies adopting reverberatory furnaces, which are solely used in the United States of America.

Primarily, the manufacture of blackheart postulates the melting of a low-carbon iron, whereby a much greater malleability results; now this reduction of carbon content (obviously not a question of decarburisation on annealing) cannot be obtained in the cupola where, inversely, the metal carburises by contact with the fuel. The elimination of carbon can be made in the reverberatory furnace, but as the "life" of the metal diminishes progressively as the carbon content decreases, it is essential to develop much higher temperatures—easily secured in the open-hearth furnace—but requiring greater fuel consumption in the reverberatory furnace.

Depending upon the furnace capacity, this consumption is in effect 25 per cent. at a minimum and often reaches 50 per cent. Besides, reverberatory furnace melting gives rise to a partial oxidation of the elements of the charge, especially of silicon and manganese, whilst the sulphur content is increased by contact of the products of combustion with the surface of the metal bath.

Despite its superiority over all other methods in use, it is apparent from this *résumé* that the reverberatory furnace either does not completely solve the problem; if the results obtained with this type of furnace in certain foundries were judged practically comparable, one can affirm that these same concerns, convinced of further possible progress, ardently desired a better solution, which is now provided by the rotatory furnace.*

The Rotatory Furnace.

The basic principles underlying the designing and construction of this furnace can be summed up thus:—Attaining very high temperatures without oxidation of the metal; securing a quality of finished iron differing very little from the constituents of the charge; possible diminution of the carbon content due to the elevated temperature, without alteration of the other elements, such as silicon, manganese, etc.; protection of the bath from the products of combustion; rapidity of melting and pouring; low consumption of fuel and reduction of manual labour.

These several conditions have led to the perfection of the rotatory furnace heated by pulverised coal, and to these can be added the installation of a mixer of small capacity, and in which the melting of a solid charge can be made.

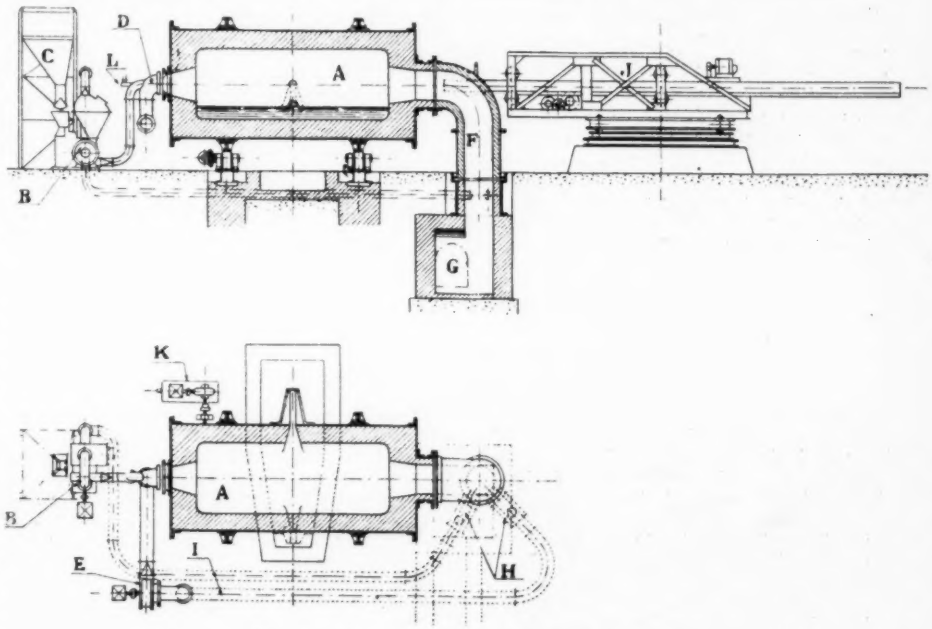

FIG. 1.—DIAGRAM OF THE ROTATORY FURNACE.

Description.

This furnace, shown in the diagram, consists essentially of a cylindrical drum A, of strong sheets, closed at its extremities by two circular plates, and lined inside with a refractory lining. The drum rests by the intermediary of two cast-steel belts on roller paths, whilst electrically-controlled gearing imparts a continuous reversible rotary movement to it.

In the centre of one of the circular plates is fixed the pulverised-coal burner D; the products of combustion escape through a central aperture in the opposite plate. The charging of the furnace is also carried out through this hole, and for this purpose the exhaust-flue can be easily and rapidly shifted round without dismantling.

The furnace carries a tapping spout and a channel diametrically opposite to it for the running-off of slag at the end of the melting period.

Heating by pulverised coal is maintained by a Resolutor pulveriser B, which is characterised by the drying of the combustible, pulverising, the separation by air to the required fineness, and distribution to the burner. The apparatus is fed with raw coal by the means of a reserve hopper C of sufficient capacity to avoid all combustible handling during the day.

The Resolutor discharges directly to the special burner, similar to the atomiser type, but carrying in addition a central oil-burner L for the lighting of the furnace and maintenance of the temperature in case of a stoppage in the pulverised-coal burning.

An auxiliary blower E supplies the secondary air, heated to 300 deg. C. by utilising a portion of the hot gases in the smoke flue G at the end of the detachable pipe F, the arrangement being shown by H and I in Fig. 1. The temperature of the mixture of air and gases is very easily regulated by means of a simple butterfly valve on the admission of air, and because of the very high temperature of these gases the quantity of inert gases admitted is small and does not at all harm good combustion. Cold secondary air permits, on the other hand, a temperature of from 1,600 to 1,650 deg. C. to be attained in the furnace proper, but the use of hot air is nevertheless to be recommended, in that it facilitates the securing of this temperature with the least consumption of coal. The question of heating the air by using actual flue gases is always attractive, and, above all, simpler and more practical than a recuperator, of which the life would be strictly limited.

The Resolutor pulveriser aspirates its own air and, in similar conditions, a mixture of air and gases to a variable temperature, depending upon the degree of dampness of the coal used, and assuring the drying of the fuel in the grinder during pulverisation.

The rotary movement of the drum is controlled by an electric motor K, coupled directly to a reduction gear, which drives the rollers by means of conical pinions.

The furnace can be charged either by hand, for small-capacity furnaces of 3 to 5 tons, or, preferably, mechanically, by means of a special charger J, when dealing with those of 5 to 10 tons. This charger, similar to type used for open-hearth furnaces, but of a simpler design, assures rapid charging with a minimum of hand labour.

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* Translated from *La Revue de Fonderie Moderne*, December 10, 1929.

* The reverberatory furnaces are not used solely in malleable foundries, but are likewise employed in other foundries, and more particularly for the melting of special irons intended for rolling-mill rolls. Normally fired by hand stoking these furnaces as those of malleable have been, in recent days, perfected by the application of pulverised-coal burning.

The furnaces in question are designed and constructed in several types, corresponding to capacities of between 3 and 10 tons. Depending upon local conditions, the position of the Resolutor in relation to the furnace is evidently variable, and it should be possible eventually to house the apparatus in a nearby shed, providing that its distance from the furnace does not exceed about 30 to 40 ft.

Working Details.

The furnace being charged and the detachable fume duct put in place, the oil is lighted and the pulverised coal later admitted; the oil heating can be continued for some time if, for example, it is a question of a first charge, with the aim of reducing the period of heating up, and to accelerate consequently the melting. Normally the oil, a less economical fuel, is utilised only at the start with a cold furnace or in case of a stoppage of pulverised-coal burning during melting.

These stoppages are, however, quite exceptional with the Resolutor installations, which give complete reliability of operation. Intermittent working of such furnaces does allow of the daily repairing, or at least the inspection of the furnace proper, and it is simple to maintain the whole in perfect working order and to take precautions against some stoppage of the installation. At the worst and in case of an accidental stoppage of the pulveriser during heating, the replacement of the grinding parts can be made in ten minutes at a maximum, during which time one would use the oil burner in order not to retard melting.

The combined heating of oil and pulverised coal can be used finally at the end of the melt to increase, if it is so desired, the temperature of the iron, especially for pouring castings of very small dimensions.

The furnace is only started in motion after the charge has completely melted, in order to avoid damaging the refractory lining. The rotation is made in the same direction at the rate of one revolution per minute. The reversing movement is used only at the end of the melt for the removal of slag through the tapping spout provided for this purpose. This simplifies the complete running-off of the slag, and allows one to have a definitely clean furnace at the end of the operation.

The instantaneous discontinuance of the Resolutor and the removal of the fume duct permits one to proceed immediately with the recharging of the furnace and the commencement of a new melt.

After melting, it is evidently possible to take samples and make final additions with the view of securing a special and well-considered quality of iron, but normally these additions are not imposed, as the constituents of the charge are not sensibly modified; it is here, besides, that the principal advantages of the rotatory furnace lie.

The conduct of the operation necessitates only simple supervision, which moreover is not permanent; a single melter can easily control the working of the Resolutor and of the furnace, and can elsewhere occupy himself by preparing the charge for the next melt. It is obviously indispensable for him to have two labourers to help him at the time of charging if done by hand, but these manual labourers are dispensed with or at least reduced by the use of a charging machine, with which charging may be effected more rapidly, thus gaining valuable time on the duration of the operation.

Working Results.

The duration of the first melt for a charge of 5 tons, and starting with a cold furnace on Monday morning, for example, takes on the average six hours, this time including the preliminary heating of the empty furnace, which lasts about 1½ hours. The duration for the following melts, the furnace being hot, is only 4½ hours for a charge not containing more than 20 to 25 per cent. steel scrap.

The charging of the furnace is effected easily in 30 minutes, and the cast in about the same time. In this way, then, a 5-ton furnace can normally take care of two casts per day of 11 to 12 hours. By recharging the furnace immediately after the second melt and taking precautions to close carefully all openings, relighting the next day is almost instantaneous, and one hour can easily be saved on the time previously mentioned.

With a furnace of 3 to 5 tons, two melts can be made in 10 hours by operating, as is understood, under the same conditions. Finally, the melting period of a 10-ton furnace varies from 6 to 7 hours, starting with a hot furnace; the use of a charging machine, which in this case is essential because of the weight of the charge, allows, nevertheless, two melts a day, that is, in 15 or 16 hours.

The analysis of the cast irons obtained averages:—C, 2.5 to 2.8; Si, 0.8; Mn, 0.20 to 0.22; S, 0.05 to 0.07, and P, 0.07 to 0.08 per cent., starting with a charge composed of 30 to 40 per cent. pig, 40 to 50 per cent. iron scrap (runners, risers, etc.), and 20 to 25 per cent. maximum steel scrap. This iron, after annealing, gives on test a strength of 24.1 to 25.4 tons per sq. in. and an elongation of 14 per cent.

The temperature of the furnace, measured by an optical pyrometer, is about 1,600 to 1,650 deg. C. at the end of melting and using cold secondary air. The temperature of the gases leaving the furnace is 1,200 to 1,300 deg. C., and the temperature of the iron at the moment of pouring reaches 1,500 deg. C. It is evident that the use of hot secondary air allows one to exceed this temperature and to reach, if desired, 1,550 deg. C., by using in addition the auxiliary heavy-oil burner at the end of the melt.

With a Ruhr coal of 27 to 28 per cent. volatile matter, 7 to 8 per cent. ash, and having a calorific value of 7,200 calories, the consumption for a charge of 3 to 3½ tons is 16 to 18 per cent.; for a charge of 5 tons it is 15 to 16 per cent., and decreases to 14 or 15 per cent. for a 10-ton furnace, with a charge containing at a maximum 20 or 25 per cent. steel scrap.

Furnace losses do not exceed 1.0 to 1.5 per cent., oxidation losses of silicon and manganese being at a maximum of 10 and 15 per cent. respectively.

Economy of the Process.

Confining the question to a comparison of the melting process in the rotatory furnace with cupola melting from the angle only of coal consumption, the other factors, labour, quality of iron obtained, reduction of wasters, etc., being less easily calculated, and moreover distinctly in favour of the rotatory furnace.

The price of coal mentioned is 120 francs per ton (19s. 4d. per metric ton); if there is added to this the cost of pulverising, say, 2s. 6d. per ton, maximum, the price of coal in the pulverised condition finally results at £1 1s. 10d. per ton. On the other hand, the cost of coke used in the cupola is £1 5s. 9d. per ton at a minimum.

Whereas the coal consumption of a 5-ton rotatory furnace is 15 per cent., the coke consumption in the cupola reaches 16 per cent., without counting the lighting fuel. The expenditures for coal and coke are therefore, respectively, in the two cases and for 1 ton of iron, 3s. 3d. for the rotatory furnace and 4s. 2d. for the cupola, resulting in a saving of 11d. per ton with the rotatory furnace.

Although appreciable, this saving is really negligible when compared with other advantages of the process which can thus be summarised.

Advantages of the Rotatory Furnace.

The burning of pulverised coal allows complete combustion without excess air; one can attain elevated temperatures without any oxidation, and the furnace losses are negligible.

Due to the rotating movement of the furnace, the bath is not heated solely on the surface, but absorbs the calories accumulated in the furnace lining previously in contact with the flames; in this lies the rapidity of melting. As soon as molten metal is obtained, the liquid iron descends below the protecting layer of slag, and is then preserved from the action of the air and of products of combustion. Whilst in the cupola, the finely-divided drops of iron run through a long distance, traversing an oxidising atmosphere before reaching the hearth; thus causing very high furnace losses.

The rotation of the furnace also allows the securing of very homogeneous casts and a metal of constant quality; the temperature is in addition very regular throughout the mass, and one can, without fear of oxidation, superheat the bath and reach a temperature of from 1,500 to 1,550 deg. C.—a factor extremely favourable for pouring castings of very small dimensions. This high temperature also allows a diminution of the total amount of carbon present as well as assuring a fine division and complete dissolution of graphite.

Because of this high temperature, the iron is more fluid and quieter than that obtained in the cupola; one can pour castings of very small section, and the moulds are filled entirely, having a negligible piping in the feeding heads; the proportion of wasters and scrap is in consequence at a minimum. The labour for the working of this type of furnace is reduced, and one melter suffices to conduct the operation.

It is incontestable that the greatest advantage of the furnace lies in the fact that the analysis of the cast iron obtained differs very little from the constituents of the charge. It is therefore possible, starting with known elements suitably proportioned, to obtain practically and without final addition, or special precautions, in the course of working, the quality of metal desired. The system of heating and its security of working assures, as well, a perfect regularity of the production and the continuity of fabrication.

The substitution of coal for coke ought to be fully appreciated in every foundry, and especially in malleable foundries, which for the greater part now use pulverised coal for the heating of their annealing furnaces. It can thus be affirmed that this new process of melting by the rotatory furnace is susceptible, by reason of its numerous advantages, to a great development, not only in the malleable foundry, but, in a general way, in all iron foundries, and perhaps, very shortly, in certain steel foundries.

Iron and Steel Output in December.

The National Federation of Iron & Steel Manufacturers report that the number of furnaces in blast at the end of December was 162—a net decrease of one since the beginning of the month. The production of pig-iron in December amounted to 643,000 tons (compared with 631,400 tons last November and 540,400 tons in December, 1928), and included 190,400 tons of hematite, 259,700 tons of basic, 144,300 tons of foundry and 24,700 tons of forge iron. The December production of steel ingots and castings amounted to 661,200 tons, compared with 815,000 tons last November and 683,100 tons in December, 1928. The December output figures bring the total for the year to 7,579,500 tons of pig-iron and 9,654,700 tons of steel ingots and castings, compared with 6,610,100 tons and 8,519,700 tons respectively in 1928. The following table shows the average monthly production of pig-iron and steel ingots and castings in 1913, in 1920, and the last four years:—

Monthly average.	Pig-iron.	Steel.
	Tons.	Tons.
1913	855,000	638,600
1920	669,500	755,600
1926	204,800	299,700
1927	607,700	758,100
1928	550,900	710,400
1929	631,600	804,600

Tests on a Hydraulic Fettling Plant.*

By Prof. U. Lohse, Hamburg.

At the end of a Paper entitled "Methods of Fettling Castings: Developments, Past and Present,"[1] which he read at Stuttgart in 1927, Director Sipp made some statements as to the experience gained with the hydraulic jet method of fettling; while extensive tests on the relations between nozzle diameter, water pressure, and the time taken for fettling have been published by Oberingenieur Gertreud[2] and Dr.-Ing. Max Mager.[3] All these writers come to the conclusion that the hydraulic fettling process saves time and wages, more especially where larger and complicated castings with a number of cores have to be treated.

Since then, the Badische Maschinenfabrik, Durlach, have supplied a hydraulic fettling plant, consisting of two fettling sheds, for the foundry of Messrs. Lanz, Mannheim, and this has been working satisfactorily for several months; and, thanks to the courtesy of these two firms, an opportunity was now afforded the author of making tests on the plant actually in operation. These tests are intended primarily to give information as to the best diameter of nozzle and the best or most economical water pressure to use compatible with the shortest times of fettling. The object was also to investigate the effect of the hydraulic jet on the various moulding materials.

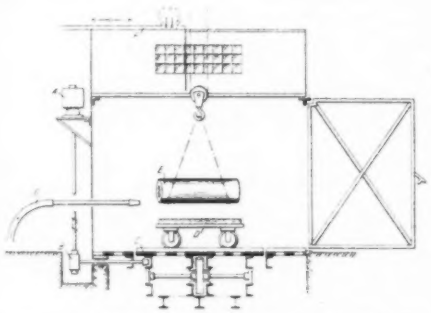

FIG. 1.—FETTLING HOUSE OF HYDRAULIC FETTLING PLANT (LONGITUDINAL SECTION).

A—Motor for Operating Turntable; B—Worm Drive; C—Turntable; D—Portable Support for Castings; E—Casting; F—Sliding Roof; G—Hydraulic Spray Pipe with Nozzle.

The Plant.

The general make-up of the plant is shown in Fig. 1. It comprises two sheet-iron chambers. One of the longer walls is formed by double doors, which are opened for putting in and taking out the castings, etc., to be fettled. At the same time, the roof can be slid back to allow the crane hook to be run in and out. The rear of the longer walls—the service side of the fettling room—is provided with windows through which the fettler can observe the fettling process. The inside of the chamber is lit from the outside by a high candle-power reflector lamp. The observation windows are constantly sprinkled with clean water from the inside to flush off dirt, etc., which may adhere to them. The fettling sludge is pumped from the foundation pit through a pipe and into a tank wagon, which transports it away. An overflow is provided to allow the water to flow off into a trough. Owing to the small quantities of water used for the fettling process, it is generally not a paying proposition to use the water over again, although it could, of course, be so used after suitable cleansing.

In the lower part of the fettling window there is a series of openings closed by revolving covers, and through these the fettling pipes pass. These pipes are about 6½ ft. long, the spray nozzles being screwed on to the front ends. One of these nozzles is straight, and the other bent through an angle of about 90 deg. to enable the water to penetrate into all the corners of the casting. At the rear end, close to the flexible pipe connection, a cross-bar is fitted to the nozzle pipe, to enable the operator to hold the pipe and guide the nozzle.

It is essential to bring the nozzle quite close up to the casting and to pass it directly into its cavities so as to remove the core completely by the full effect of the water jet. The farther removed the nozzle opening from the casting, the less intense is the effect of the jet, as the water jet spreads out on all sides with increasing distance from the nozzle.

After fettling a fairly large casting the core irons will have been completely loosened by the jet and so can be withdrawn by hand without having been warped. They can be used again straight away without having first to be straightened, as is otherwise usually the case. Even under this head, then, time and money are saved. There was practically no rusting.

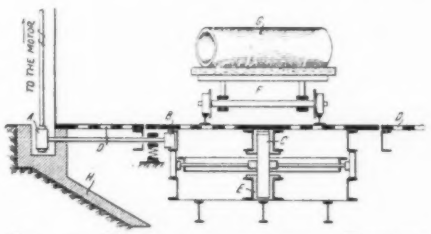

FIG. 2.—METHOD OF OPERATING FETTLING TABLE OF HYDRAULIC FETTLING PLANT.

A—Worm Drive; B—Friction Wheel; C—Turntable; D—Grate (grille); E—Bearings; F—Truck; G—Casting; H—Foundation.

The diagrammatic sketches, Figs. 1 to 3, show the lay-out of the fettling chamber. In the longitudinal section (Fig. 1) will be seen the open door on the right, through which the crane runs the casting E and lowers it on to the truck D, the roof F being slid back. The truck rests on a turntable C, which can be revolved from the outside to allow the castings to be set at the proper positions to the nozzles while they are being fettled, without anyone having to enter the chamber. On the left will be seen the window wall with the openings through which the fettlers apply the nozzles to the castings.

Fig. 2 shows the method of operating the fettling table. The vertical shaft of an electric motor mounted on a bracket on the outer wall operates a worm gear A, which, acting on the horizontal shaft of a friction wheel B, drives the turntable C. Both the turntable and the floor D of the fettling chamber are perforated to allow the sludge from the fettling process to flow down into the foundation pit H. The periphery of the turntable is mounted on wheels, and the table centred by a pin into the bearing E. The truck F carrying the casting G is covered by a wooden slab, and runs on a narrow-gauge track. The general lay-out of the fettling chamber is shown in Fig. 3. The doors are open, and the roof is slid back by means of a rack gear operated by a sprocket and chain from below. A top-light admits daylight into the chamber. The illustration shows the chamber ready for running in or taking out the castings being fettled. The general lay-out of a hydraulic

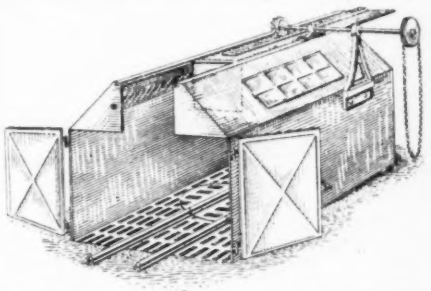

FIG. 3.—HYDRAULIC FETTLING HOUSE WITH SLIDING ROOF.

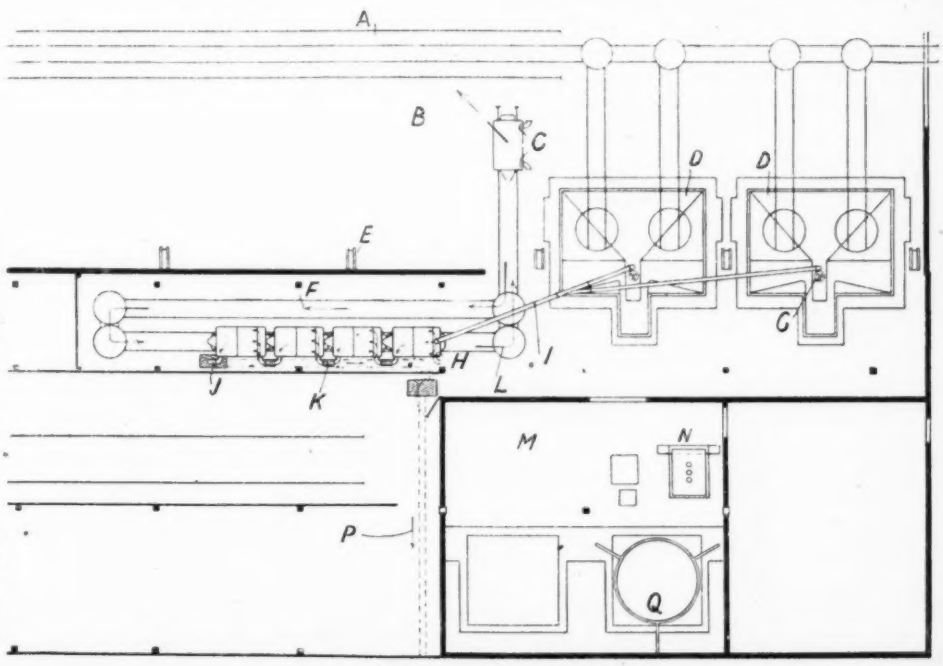

FIG. 4.—HYDRAULIC FETTLING PLANT.

A—Standard Gauge; B—Discharge by Crane into Wagon; C—Seals; D—Duplex Hydraulic Fettling Houses; E—Runway Joists; F—Discharged Sludge Wagons; G—Sludge Pump and Electric Motor; H—Seal (shutter); I—Pipe-lines from Sludge Pumps; J—Drain (discharge) Pipe; K—Flexible Rubber Pipe with quick Fixing Joint; L—Full Sludge Trucks M—Hydraulic Room; N—Hydraulic Pump; O—Compressed Air House; P—To Settling Pond; Q—Hydraulic Accumulator.

* Extracted from "Die Giesserei," December 6, 1929.
1 "Die Giesserei," 1927, p. 607.
2 "Giessereizeitung," 1928, p. 50.
3 "Die Giesserei," 1929, p. 205.

XUM

fettling plant with two fettling chambers is shown in plan in Fig. 4. Each chamber has two turntables for carrying the fettling trucks. The castings are run in and out by means of turntables running above a narrow-gauge track. The hydraulic pump and accumulator are housed in a separate room behind the fettling houses.

The muddy water is pumped from the foundation pits of the chambers by electrically-driven pumps, and through pipe lines into the first of a row of four sludge wagons coupled together. The overflows of the truck reservoirs are connected to each other by bends and quick-coupled flexible rubber pipes, while the overflow of the last truck carries the water through a drain pipe into an underground main, whence it flows into a settling pond. By overflowing from one truck to the other the sandy mud has time to sink, and is thus pre-clarified. When the first truck has been filled to overflowing with mud it is uncoupled and run via turntables into the fettling shop, and there discharged by means of a travelling crane into railway trucks standing on a standard-gauge track. The empty truck is then shunted behind the row of trucks and coupled to the rear one. During the emptying process the line of trucks is moved forward one truck. The front truck has meantime been pumped full of sandy mud, and is then uncoupled for emptying. Thus, while one truck is being conveyed to the railway truck and discharged, the next one is being filled with sludge,

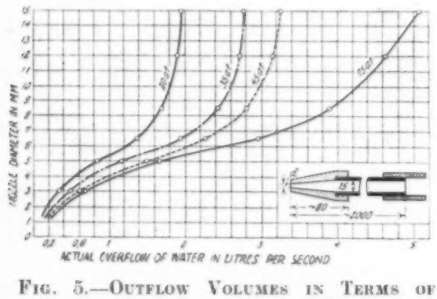

FIG. 5.—OUTFLOW VOLUMES IN TERMS OF NOZZLE DIAMETER AND WATER PRESSURE.

and, after being uncoupled, it is emptied, and so forth. This arrangement allows the fettling sludge to be removed without interrupting the work of fettling.

The Tests.

The first tests carried out were made with a view to ascertaining the volumes of flow with the nozzle diameters of 0.118, 0.196, 0.24, 0.32 and 0.46 in. and the available hydraulic pressures of 20, 35, 45 and 75 Atm. (285, 500, 640 and 1,066 lbs. per sq. in.). In addition, the flow from a 0.58-in. nozzle at the various pressures was ascertained. All the pressures were produced from weight accumulators. The flows were ascertained by observing the time taken by the accumulator weight to fall from a definite height. An accumulator having a piston diameter of 12¾ in. was used for the pressures of 285 to 604 lbs./sq. in. It was possible to read the stroke accurately, the figure being 4 ft. 11 in. for each test. The volume of water consumed per second was accordingly found to be 26.6 gallons. For the measured time of 144.6 seconds, the volume of water delivered per second works out at 0.1841 gallons. The same procedure was followed in the tests at 1,066 lbs./sq. in. pressure. Here the piston diameter of the accumulator was approximately 13 in., while the measured stroke was approximately 3 ft. in each case, so that the volume of water consumed in the time amounted to 16.42 gallons.

The quantity of water actually flowing from the nozzle is, however, slightly less, as leakage losses occur and must be deducted. A check test was made, when these losses were found to be 0.0541 gallon per second in the first accumulator and 0.025 gallon per second in the second accumulator (1,066 lbs. pressure). These volumes must therefore be deducted from the ascertained volumes of water.

In order to ascertain the theoretical outflow volume the theoretical rates of flow v were calculated, and for a pressure of 20 Atm. (284.4 lbs.), for instance, the velocity of flow is found to be 20.5 ft. per second. We thus get for, say, a nozzle diameter of 0.118 in. a flow of 0.0974 gallon per second. The quotient of actual and theoretical flow represents the efficiency η of the nozzle. Accordingly, in the example given

$$\eta = \frac{0.080 \cdot 100}{0.0974} = 82.5 \text{ per cent.}$$

Higher efficiencies are always obtained with the smaller-diameter nozzles.

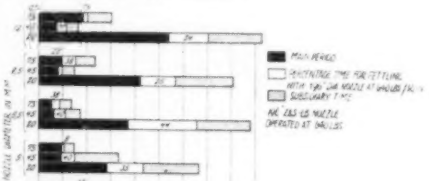

FIG. 6.—DISTRIBUTION OF TIMES FOR FETTLING A GEAR CASING.

The actual outflow volumes at different pressures and with different diameter nozzles are plotted on the curve sheet (Fig. 5), the volumes in litres per second being plotted on the abscissæ and the diameters of the nozzles on the ordinates. In the same figure, the longitudinal section through the nozzle, with nozzle tube and hose end is drawn in. It will be seen that the curves deviate more widely at the different pressures with increase in the nozzle diameter. Here we see the advantage of using smaller-diameter nozzles for keeping the water consumption to a minimum. The economy of the plant is also, however, governed by the time taken in fettling the castings. The times for fettling a gear casing and a crankcase of the Lanz Bulldog Tractor with different sections of nozzle and at different pressures were established by test. It was not possible to ascertain the exact fettling time for the small nozzle diameter of 0.118 in., as the efficiency was very small, and an angular nozzle of 0.196 diameter had to be used to clean

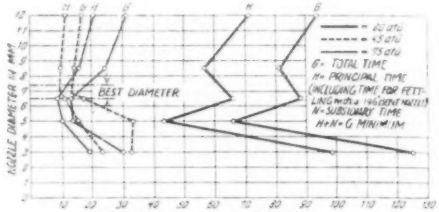

FIG. 7.—THE SHORTEST TIME FOR FETTLING THE GEAR CASE IS OBTAINED WITH A NOZZLE APPROXIMATELY 7 MM. (.275 IN.) DIAMETER.

the casting properly. In addition, the low pressure of 284 lbs. was not sufficient, and it had sometimes to be increased to 640 lbs.

These tests showed that the time required for fettling the gear casing closely approximated to the time required for fettling the crankcase. For purposes of greater convenience, the ascertained times of fettling, together with time taken

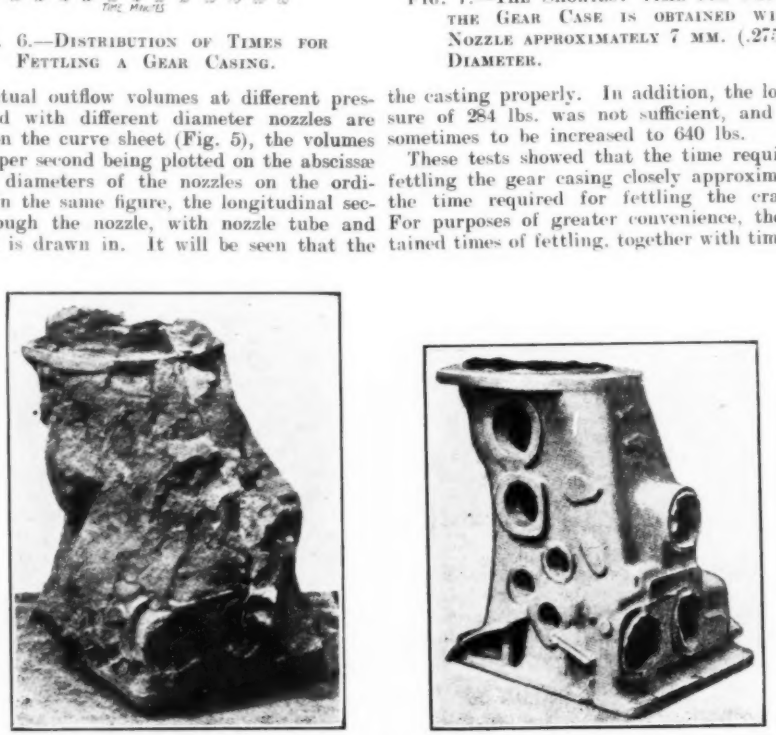

FIG. 8.—CRANKCASE BEFORE AND AFTER WET CLEANING.

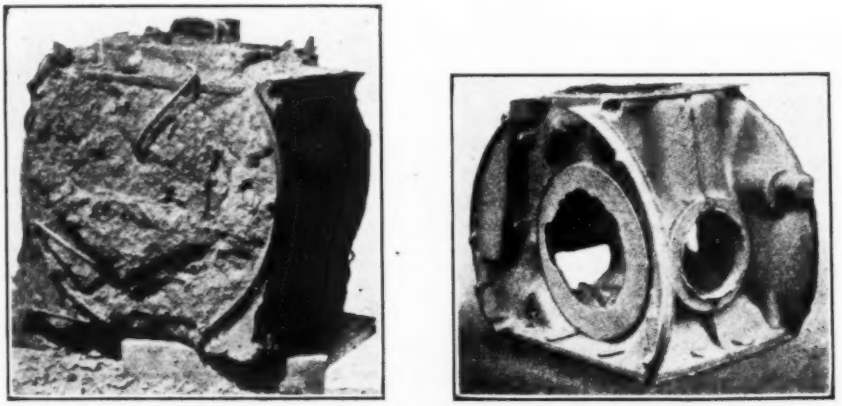

FIG. 9.—GEAR CASE BEFORE AND AFTER FETTLING.

on auxiliary operations, and total time, are plotted in the diagram Fig. 6. Three different fettling times are distinguished: (1) main period, during which a straight nozzle is applied to the casting; (2) the time taken on applying the bent nozzle to the casting, and (3) the subsidiary time spent in altering the position of the casting in relation to the water jet, during which period the jet was not applied to the casting. Here, again, there was a decrease in the times of fettling with nozzles of smaller cross-section and higher pressures. It is also important to note that, in most cases, the fettling time was reduced where bent nozzles were used in conjunction with higher pressures (1,066 lbs./sq. in.).

Fig. 7 is a curve in which the times taken on fettling a gear casing are plotted in terms of nozzle diameter. For convenience, the times taken for spraying the casting with a straight and a bent nozzle are combined and called the principal time. It will be seen at once that the shortest times of fettling result where a nozzle of about 0.275 in. diameter was used.

The marked deviation in the figures for the low pressure of 284 lbs. is probably due to the fact that, as already mentioned, this low pressure was in most cases insufficient to clean the castings properly, so that the pressure sometimes had to be increased.

Figs. 8 and 9 are illustrations of the castings used in the test, (1) as they come from the moulds, and (2) as they appeared when fettled. The crankcase weighed 550 lbs. before fettling, and 374 lbs. after; the weight of the core iron removed amounted to 70.4 lbs.; so that, during a fettling time of 42 minutes, 105.6 lbs. of moulding material was sprayed off (2.53 lbs. per minute). The gear casing weighed 704 lbs. as it came from the mould and 286 lbs. when fettled, the weight of the core iron being 44 lbs.; so that, in a period of 35 minutes, 374 lbs. of moulding material were removed, or approximately 11 lbs. per minute.

In Table I are shown the times and costs for fettling various castings by hand and with water. The superiority of the hydraulic system of fettling is at once apparent in complicated castings having a number of cores.

TABLE I.—*Comparison between Dry and Hydraulic Fettling.*

Method of fettling.	Cylinder.		Crankcase.		Gear case.		Holeby cylinder.	
	Time. Mins.	Cost. S.*	Time. Mins.	Cost. S.*	Time. Mins.	Cost. S.	Time. Mins.	Cost. S.
Hydraulic—Spraying out	50	0.95	42	0.30	35	0.66	122	2.40
Chipping	75	1.48	68	1.35	55	1.08	305	6.00
Air blowing	7	0.13	10	0.19	9	0.18	—	—
Total	132	2.56	120	2.34	99	1.92	427	8.40
Dry fettling—Fettling and chipping	152	3.00	183	3.60	132	2.60	492	9.70
	Fettling process alone.							
Comparison—By hand	78	1.52	115	2.25	78	1.52	188	3.70
With water	50	0.95	42	0.80	35	0.66	122	2.40
Difference	28	0.57	73	1.45	43	0.86	66	1.30
Weights—Unfettled	506 lbs.		550 lbs.		704 lbs.		1,564 lbs.	
Fettled	330 lbs.		374 lbs.		286 lbs.		968 lbs.	
Core irons	26.5 lbs.		70.4 lbs.		44 lbs.		26.4 lbs.	
Quantity of sand	149.5 lbs.		105.6 lbs.		374 lbs.		569.6 lbs.	

* "S." = shillings, the German mark equalling approximately 1s.

In order to test the times of fettling in terms of moulding material, a series of moulding boxes of the same base area and approximately the same volume were filled with moulding sand, S, which was rammed down tight and sprayed from the box after being allowed to dry. A second set of test moulds were rammed out with lean core sand, M, with the addition of sawdust, mixed in the proportion of one part of fresh sand to one part of floor sand; while a third set of moulds was filled and rammed with firm core sand, F, without any added sawdust, the sand used consisting of two parts of fresh sand to one part of floor sand. Sand from Kaiserslautern was used in every case.

The times for spraying out these boxes at a hydraulic pressure of 1,066 lbs. and using different diameters of nozzles were ascertained. These times clearly showed that the nature of the moulding material has a big effect on the time taken for fettling. It was proved that the lean moulding sand, S, was sprayed away most quickly; the lean core sand, M, took about 1.8 times as long to remove, and "fat" core sand, F, took 1.5 times as long as the leaner sand.

A test was also made with oil-sand cores. Using a 0.196-in. nozzle and a pressure of 1,066 lbs., these cores were fettled as cleanly as were the moulds filled with moulding sand. It has been found that the hydraulic fettling method can be used with advantage for any kind of moulding material.

The tests have confirmed the fact that small-diameter nozzles and high pressures give a better fettling effect than large-diameter nozzles at the same pressures. Close observation of the wet fettling process easily explains this apparent contradiction, because a fine jet projected at a high pressure acts in a similar way to the point of a chisel. This brings away the moulding sand easily in large chunks from the castings.

The tests have also demonstrated that the hydraulic fettling process using small-diameter nozzles and high pressures is admirably suited for fettling cheaply larger castings having a number of cores, and for all kinds of moulding material. It saves a considerable amount of time as compared with hand-fettling. The result is a reduction in the wages paid to fettlers, amounting to sometimes 40 per cent. and more, according to the shape and size of the casting treated. In addition to these economic advantages, the gain from a hygienic standpoint is marked, because dust, which is an inevitable concomitant of other fettling methods, and which is both troublesome and injurious to health, is eliminated in hydraulic fettling.

Discussion.

DR. BREHM asked Prof. Lohse how he arrived at his comparative figures. Were capital charges included in the costs for the hydraulic fettling plant, or were the costs shown merely operating costs?

PROF. LOHSE replied in the negative, and said they referred only to wages.

HERR MITTEL asked whether tests had been made for comparison with sand blast.

PROF. LOHSE, in reply, said he was not aware of any. He did not think it was the purpose of the hydraulic method of fettling to replace sand-blasting entirely. That would probably never happen.

HERR MITTEL, continuing, said that he had made tests and found that, with the 0.236-in. nozzle, the water was atomised, and that the jet must be brought up as close to the work as possible in order to free difficult cores. Moreover, nor could he obtain successful results with the bent nozzle. The author had stated that the jet acted like a chisel, but this chisel effect ceased when one moved the jet away from the casting.

PROF. LOHSE said the form of nozzle must be made suitable and must be kept right up to the job—not farther away than 4 in.

HERR MITTEL, commenting on the difficulty of disposing of the sludge, said he noticed that it was allowed to overflow from one tank to another in a row of four to five tank trucks. But the remains of the sludge entered into the clearing tank, deposited, and stuck there, and involved considerable expense for its removal, and this was a point that must be considered when dealing with the cost of the process.

PROF. LOHSE: The mud must be clarified to the greatest possible extent so that as little mud as possible remains in the tank. The tank or pit must be cleaned out frequently before the mud has hardened. In that case the expense was not very great.

DIPL.-ING. SPOLDERS, Vereinigte Stahlwerke (Wanheim Works), said that unfortunately he had not been able to confirm the tests of Herr Prof. Lohse with regard to large and small jets. He had carried out tests at 3,700 lbs. and had found a definite ratio between the atmospheric pressure and the diameter of the nozzle. The higher the pressure adopted, the higher must be the relative diameter of the nozzle. There was sure to be difficulty from the jet atomising when anyone begins working with the water jet for the first time. This was due to the design of the nozzle. His works had found that, after a working period of approximately one hour, the nozzle, constructed of standard material, had worn and scored so badly as to cause the hydraulic jet to atomise. It was also found that the best distance from the castings was 4 in., as the jet had the best cutting speed at that distance.

HERR WÜST, Saarbrücken, asked what happened to the sand that had been removed.

PROF. LOHSE, in reply, said it could either be discarded or reclaimed. This had actually been done.

HERR SIPP, Mannheim, said the question had been raised as to whether the hydraulic fettling process could be regarded as a substitute for sand-blasting. His experience shows that sand-blasting would be retained for all types of castings that are of such dimensions that they can be brought up to an enclosed chamber fitted with a dust extractor, and where the castings had few, if any, cores—primarily small machine-moulded castings made in green moulds. It was in cases of this kind that the advantages of sand-blasting—low wages, good fettling, and considerable freedom from dust—were manifest. For larger castings, mainly those made in dry sand and having a number of cores and a complicated shape, the hydraulic method of fettling was the one to use, as this method also ensured freedom from dust and showed a saving in wages. There was no reason to fear that the hydraulic jet would not get properly into all the corners of the castings. Prof. Lohse has already mentioned that bent nozzles were used as well as straight ones. These nozzles enable the jet to penetrate into lateral and concealed spaces and remove the sand. At any rate, many years of experience with the method at Messrs. Lanz's works has shown that even the most complicated castings can be successfully fettled by the hydraulic process. The method could also be successfully adopted to oil cores.

A NEW MILL is to be installed at the Newport works of the Whitehead Iron & Steel Company, Limited.

A Recently-Introduced Aluminium Alloy.

In a Paper presented to the Institution of Production Engineers at its meeting on January 2, MR. W. C. DEVEREUX (managing director of Messrs. High Duty Alloys, Limited, Slough) discussed some recently-introduced aluminium alloys, particularly one known as "R. R. 50," which is regarded by leading engineers, in the aircraft industry especially, as representing a distinct advance in the use of aluminium. It is the outcome of careful work done by Messrs. Hall and Bradbury, who have charge of the laboratory of Messrs. Rolls Royce, Limited, the latter having been issued Letters Patent for this alloy. Much development work in regard to this material has been done by Messrs. High Duty Alloys, Limited. So much is thought of this material by Messrs. Rolls Royce that the whole of their car and aero-engine aluminium castings are now made of it, and Mr. Devereux regards it as a certainty that the forgings now used by them in other aluminium alloys will be made in the new material. As proof of the sterling qualities of this new alloy, he pointed out that the famous engine, installed in the winning plane of the Schneider Trophy Race this year, had the crankcase, cylinder block and cylinder head, together with the other aluminium castings, made of it. It is the most easily cast aluminium material that he has handled, and the most valuable in service, and, he urged, will do much to ease the work of the modern foundry and light-alloy forge.

Compositional Limits.

The composition is as follows:—Copper, 0.5 to 5.0; nickel, 0.2 to 1.5; magnesium, 0.1 to 5.0; iron, 0.6 to 1.5; titanium, up to 0.5, and silicon, 0.2. to 5.0 per cent., with aluminium as the remainder.

This composition is wide, and for the various application the elements were divided into four grades—one for sand and die castings for general purposes, one for die castings for pistons, another for forgings for general purposes and a fourth for forgings suitable for high-quality pistons. All graduations of the material were capable of strengthening by heat-treatment. The forgings had a high temperature heat treatment, and, after quenching, were subjected to an ageing process; the castings were subjected to a low-temperature treatment. The temperature for the treatment of the castings was not higher than 175 deg. C., so that distortion or cracking during quenching (which was usually encountered when high-temperature treatment was resorted to) was obviated. The casting and forging of this material was undoubtedly easier than in any other known aluminium alloy, but the machining called for some little extra care.

Modified Al-Si Alloys.

Mr. Devereux then went on to refer to other recently-introduced alloys and to compare their properties with those of R. R. 50. Dealing with aluminium-silicon, both in its modified and unmodified forms, he said a factor that had favoured the use of this material was its ease of casting, which enables thin sections to be cast without cracking. On the other hand, this alloy, whether in the modified or unmodified form, had such a low-proof stress that it is serviceable only in parts subjected to comparatively low stresses, such as railway carriage doors, covers and so on. So much had been written in recent years of the importance of the modification process, he said, that certain sections of the engineering industry had been persuaded to use the modified material, whereas careful investigation of their requirements would have shown that satisfactory service could have been obtained from the material in the unmodified state, and considerable saving effected. The modifying process, invented by Dr. Alidar Pacz—and which certainly made for improvement—consisted of treating the aluminium-silicon alloys, containing from 5 to 20 per cent. of silicon in the molten state before casting, with an alkaline fluoride, or a mixture containing an alkaline fluoride with an alkaline chloride, or a substance which under this treatment would yield an alkaline fluoride. He personally had investigated numerous sand castings made by this process, however, and had rarely found a sand casting which has been perfectly modified throughout, in both the thick and thin sections. Even should the modification be satisfactory, the results were not such that one would care to introduce the material for casting a stressed part. Again, in gravity die-casting, the metal was held for such long periods in a ladling-out furnace that there was a tendency for it to revert. A certain amount of modification or refining was done by the chilling in the die, but it was better, in sand casting, to avoid the present hit-and-miss system of modification and to use either another method or an entirely new material which, whilst giving equal ease of casting, would also increase the proof stress, proportional limit and elastic limit, whilst maintaining the ductility. An alloy equally easily cast, and equal in modification, might be secured by the introduction of cobalt and chromium in small quantities to the common aluminium-silicon alloy, or by the introduction of chromium, cobalt and tungsten. This gave the necessary refinement to the material, so that one could cast it without such a careful control of the modifier or the time of the melt to suit the amount of modifier used, and the material could also be held for long periods without its physical characteristics being affected. This introduction of additional elements to the cast gave a material conforming with both the Air Ministry Specification DTD.25 and the Admiralty Specification D.N.C./M/1 and 1A, but did not make the material more serviceable for use in highly-stressed parts. It was not until the introduction of the R. R. 50 material that this last object was attained. It was as easily cast as an aluminium-silicon alloy; it was notably free from hot shortness and shrinkage cracks; it had a remarkably high-proof stress; and it gave a dense casting, so that it was ideal for parts which must be non-porous.

In the casting of the numerous parts that have been made in this material for the aircraft industry, if cast correctly, he had not found it necessary to use chills. The material was very fluid, and high temperatures for casting thin sections could be adopted without detriment.

Except for the making of forged pistons, "Y" alloy had been largely supplanted by the R. R. 50 alloy, which is known by the trade name of "Hiduminium" R. R. 50. Unfortunately, in order to obtain the best results in "Y" alloy, heat-treatment at a high temperature was necessary. The elongation was low, whether or not the material had been heat-treated, but the particular trouble was the distortion which occurred during heat-treatment or quenching. "Y" alloy has proved extremely serviceable for parts which were subjected to high temperatures, and it would still be used for such parts, in his view.

Comparison with "Y" Alloy.

After discussing the methods for the successful casting of "Y" alloy, he said that the heat-treatment necessary to enable the castings to attain their full physical quality involved the heating of them to 520 deg. C., 2 hrs. soaking being sufficient for smaller castings and 4 hrs. for the larger ones. After soaking, each casting should be quenched in boiling water, followed by a further heat-treatment at 220 deg. C. for from 2 to 4 hrs., the casting being allowed to cool in the furnace. He has found that the only satisfactory way of heating the larger castings to the comparatively high temperature necessary was by means of the salt bath. The electric furnace was satisfactory for small castings or for forgings, where the difference in temperature of the different parts, due to the variation in the thickness of sections, is not so detrimental. It was true, he added, that the temperature in an electric furnace can be controlled to a high degree of accuracy, and it would vary little over the various parts of the furnace, but owing to the variation of thickness of the various parts of the average large casting, and the fact that some parts of the castings were nearer the furnace walls than others, uneven heating would result during the initial raising of the temperature. It was to this variation that he attributed many of the troubles, such as cracks and distortion in the castings, during treatment. His method had been to submerge the casting in broken frozen salt and then to heat it to the temperature required; the salt, becoming liquid, surrounds the whole of the casting, ensured evenness of temperature throughout the casting during the temperature rise, and held it at that temperature accurately throughout the soaking period. The furnace used for the operation was oil-fired. The salt was contained in a steel bath, 6 ft. by 2 ft. by 20 in., supported on a firebrick pier held by steel plates. The oil consumption was approximately one gallon per hour. It was found that the furnace, which works for the full 24 hours on six days per week, needed rebricking approximately every two months, and the bath needs local welding about every three months. His firm had treated hundreds of castings of various sizes by this method, and rarely had they experienced trouble due to cracking. Nevertheless, care must be taken to support the castings thoroughly in the bath, and, however careful one might be, a certain amount of scrap was produced during this high-temperature treatment when applied to castings. The salt used in the bath was a 50/50 mixture of sodium and potassium nitrate, and there was no necessity to arrange any artificial stirring of the salt at temperature in order to secure evenness of heating. Temperature control, of course, was essential. His firm had twelve large baths; a permanent thermo-couple was connected, not only to the indicators which were read by the men operating the furnace, but also to recording indicators in the laboratory. No work was allowed to be taken from any bath until a Release was obtained from the laboratory that the temperature had been maintained accurately during the immersion of the work.

Casting the R. R. 50 Alloy.

Discussing the casting of the R. R. 50 alloy, he said that in the first place the pattern should be studied, in order that ample provision should be made for getting large runners and risers well distributed. It was desirable to get the metal into the mould as quickly as possible, and to have sufficient material in the runners and risers to continue feeding the casting while shrinkage is taking place. One need not be afraid that the runners and risers, owing to their size, would cause draws. Chills should not be considered as a means of overcoming draws, unless the place to be chilled was in some isolated part of the casting and cannot be fed. The temperature of pouring for the average casting was from 700 to 720 deg. C., but for extremely thin sections higher temperatures could safely be adopted. He had found that an increase of temperature overcomes the tendency to draw in a portion of the casting. The statement that higher temperatures can be adopted must not be taken too generally, however. For example, a fan casting would not fill at 730 deg. C.; at 770 deg. C. the mould filled quite well, but indications of small gas inclusions were traced in the heavy centre boss; at from 740 to 750 deg. C. the

(*Continued on page 70.*)

Production of Castings for Internal Combustion Engines.

The December meeting of the East Midlands branch was held at the University College, Nottingham. Mr. J. Lucas, Branch-President, occupied the chair.

MR. J. LUCAS, who introduced Mr. Key, said the object of holding a meeting in Nottingham was to infuse more interest among the foundrymen and encourage them to join the Institute. At present there were very few Nottingham members, and he was hoping that by their efforts that night some good would result.

MR. KEY, who gave an address on "Production of Castings for Internal Combustion Engines," exhibited a number of lantern slides. His chief object, he said, was to convey an idea of the scope of the Institute in so far as it applied to the mutual exchange of views and opportunities of gaining knowledge in connection with founding along with its kindred sciences, arts and crafts, design, patternmaking, metallurgy and founding materials. The demands of the engineer from the foundry were to-day much more exacting than before. Castings were more complicated, for it seemed to be the aim of the designer to embrace as much as possible in any one casting, whereas before he was content to make one main casting and machine and make provision for fastening on the details. To-day as many details as possible were included in the main casting. This, along with a demand for a stronger material, often coupled with a specified analysis, helped to make the founder's lot a somewhat thorny path.

This state of affairs (proceeded Mr. Key) had its advantages, as it made the task of the foundryman one of which it was well worth striving to become the master, and that was where the Institute became a valuable asset from the opportunities of gaining knowledge and learning the results of the other person's practical experience. Generally, it created and stimulated a thirst for further knowledge, the attainment of which, apart from obtaining prestige, was a reward well worth having.

Influence of Various Elements on Cast-Iron.

He then illustrated a six-cylinder combustion engine of 50 b.h.p. per cylinder which ran at 300 r.p.m. on residual oil and was also made to run with producer gas. The main components were of cast iron; in fact, 75 to 80 per cent. of the whole engine was of cast iron. Pig-iron contained, in quite appreciable quantities, silicon, phosphorus, sulphur, manganese and carbon, and often small quantities of copper, arsenic, chromium, nickel, titanium, etc. Those elements conferred characteristic properties to the pig-iron, and their influence was determined by their proportions present in relation to one another. Taken in their order, silicon was present in ordinary pig-iron up to about 4 per cent., and in the main had often a softening effect and, in general, as silicon increased, shrinkage and strength decreased, therefore the strongest irons usually had a low silicon content. With regard to phosphorus, this, he said, was present in ordinary irons up to 1.5 per cent. and was valuable in promoting fluidity to molten iron, although high phosphorus caused brittleness; therefore, where strong irons were required phosphorus should be reasonably low. Sulphur had a detrimental effect when present in any appreciable quantity and rarely exceeded 0.15 per cent. in cast iron; its chief effect was to cause hardness and to render molten iron more sluggish, thus increasing the tendency to entrap gases and cause blowholes. In the main sulphur should be kept as low as possible.

Manganese, he said, was alloyed with pig-iron up to 2 per cent., its influence being to render iron more fluid, and it would help to increase the strength as well. Carbon was present in two forms, one form being combined with the iron as carbide of iron. The amount which was combined depended largely on the amounts and influences of the elements he had already mentioned, and the amount of combined carbon was a direct measure of the hardness. The hardness increased until when about 1 per cent. was present, the limit of commercial machinability was reached. The other form of carbon—graphite—was just the opposite in effect. The presence of graphite carbon had a great effect on strength. The smaller the size of the flakes, and especially when they were of the curly form, the stronger the iron would be. The size and form of the flakes were determined by cooling conditions along with the proportions of some of the other elements present.

Instituting Technical Control.

Mr. Key, who proceeded to illustrate what a complex material cast iron was, said that with so many components and varying in such a wide range some thousands of combinations could be made. To emphasise this more fully, they could take as a comparison the influences of strychnine in water. A certain number of drops of strychnine added to water made a valuable tonic, but if the number of drops were increased the mixture became a deadly poison. The varying proportions of those elements had a direct bearing upon the appearance of the fracture of pig-iron, but at the same time those proportions which were determined by analysis and were expressed to determine the grade, did not necessarily determine the value of the material as being best suited for the purpose for which it was required. Comprehensive tests were taken of all materials. Pig-iron, coke and limestone were periodically analysed and tabulated. Pig-iron charges for the cupola were all weighed and tests were taken of all special irons from the ladle for ingot chill test. It did not, however, said Mr. Key, necessarily follow that good tests were a guarantee of good castings, while, on the other hand, when the qualities of the castings were known, then allowing for other conditions being repeated and the materials used emanating from the same source, then the tests within reasonable limits could be relied upon to be satisfactory.

In the production of Diesel and semi-Diesel engines, in which cast iron played an important part, it would be readily appreciated that a thorough knowledge of the composition of the various pig-irons should be known and frequently checked, for the duties of some of the components were very exacting. This called for use of the very best of materials to be able to withstand the work. That was where the chemical laboratory, along with the metallurgical chemist, proved their value as an asset to the successful production of castings, especially so when confidence was mutual between the chemist and the foundryman, for, no matter how wide their experience, there was still a lot to be learned yet, as fresh developments were taking place almost daily.

Composition and Properties.

Comparing various irons, Mr. Key said they would find from analysis that the strongest irons were the lowest in phosphorus, also the hard irons contained rather more sulphur than the soft irons. The manganese was also higher in the hard iron to aid fluidity and strength. The Liner irons, which had to withstand most wear, contained the highest combined carbon, and naturally could not be machined at such a high speed as the soft irons, which, if examined, they would find contained the most graphite. Metallography also played an important part in connection with the control of materials, for by that means the microstructure of the materials could be reproduced by means of etching and photography. The specimens exhibited, he said, were prepared for that process by having perfectly flat surfaces, which were first filed, and afterwards all the scratches were removed by polishing with emery papers, gradually increasing in fineness, and finally with an extremely fine powder, such as rouge, on a wet pad. The specimen was then ready for examining under the microscope, and might be etched with various chemicals to reveal different constituents, and could then be photographed by means of a micro-camera, some of which were now capable of magnifying as high as 2,000 times. With regard to some of the methods of making the various castings necessary to build an engine, Mr. Key said that all castings were submitted to very rigid tests and had to conform in every respect to a specification and were expected to reach 100 per cent. perfection. Although this was not always attained, there was not a great cause for complaint, for the percentage of rejected castings seldom exceeded 2½ per cent. About 80 per cent. of the castings, large and small, were machine moulded and chiefly were made by skilled moulders. Starting from the base, they had the bedplate, which carried from two cylinders to six cylinders, and, proceeding to exhibit a picture of a four-cylinder bedplate which weighed 2 tons 2 cwts., he said that one could imagine that it was a very important part of the engine and required to be a perfectly sound and rigid casting, free from imperfections of almost any kind, such as blowholes, sullage inclusions, segregations, cold shuts, unsuitable material and, above all, casting stresses, any of which would be liable to jeopardise the stability of the engine. Cores were bolted down wherever possible with the object of eliminating the weakening effect of studs or chaplets, which were likely to cause leakages, for the casting was tested with paraffin to ensure it being sound.

After explaining details of tackle, moulding and pouring, he went on to say that cylinder-housing and crank-case castings were made monoblock up to five cylinders. The six-cylinder housings were made in two sections of three cylinders in each section. It could be appreciated that such a casting had to be as near perfect as was possible. Every facility was given after casting the housings for the relief of undue stresses, as the section varied considerably. The neck for the cylinder liner and cylinder head studs was 4½ in. square section, merging into a general thickness of ¾ in. in the body; there was also a heavy section to receive the bottom end of the cylinder liner.

Moulding and Casting Details.

The procedure of moulding and casting was: all housing moulds, with the exception of the five-cylinder, were machine-moulded — jolt-rammed. The cores were all made of oil-sand. All moulds were sprayed by means of a compressed-air blacking spray, the operation taking only a few minutes. The moulds were then stove-dried and assembled. After casting, doors or windows were removed from the front of the moulding boxes and the core removed through the end cylinders; that was mainly to counteract the evil influence of core expansion. At noon the following day the top box was raised 3 in. off the casting and the space between the box joints was filled in for the purpose of keeping the cold air away from the inside. By so lifting the top box the casting was free to move, and so take up, unobstructedly, a natural position. The casting was then left until the following day, when it was moved from the mould and transferred to the dressing shop. After machining it was subjected to hydraulic test of 50 lbs. per sq. in. The cylinder or combustion head was also machine-moulded. The casting played a very important part, as it was subjected to great heat—up to 300 deg. C.—and a compression up to 650 lbs. per sq. in., and, therefore,

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called for a perfectly sound casting. Under working conditions, the material in such a casting was repeatedly moving due to abnormal expansion and having to resume its natural position. The material used must be the very best that could be obtained, strong but not necessarily unduly hard, but of a resilient nature. The casting had to be 100 per cent. good both in regard to machined parts and soundness under hydraulic pressure. With regard to the analysis required for this casting, Mr. Key emphasised that it could be approximated by using quite a number of various makes of materials, but it did not necessarily follow that the resultant materials would all hold up to the duty called for equally as well as each other; but from experience it was known that in that particular case the brands of materials which were used to obtain the specified analysis gave the resultant material which, up to the present, had not failed the foundrymen. The percentage of failures, which was negligible, had been caused by deposits of hard scale in the water-jackets, which caused choking of the supply of cooling-water and local overheating of the metal. That only happened when the cooling water was heavily charged with salts of lime and magnesia. A modification in design had now been adopted to overcome that trouble.

Making the Liners.

Mr. Key said that cylinder liners were machine-moulded and cast in one box. The core was made of loam, swept on straw bands wrapped on a perforated cast-iron barrel. There was nothing very difficult in the making of the castings provided all the necessary conditions were rigidly observed. Each casting was run with a separate runner, and run from the top end save for the small pilot runner, which was common to both liners, this being used for the purpose of allowing sufficient metal to act as a cushion for the falling metal from the top runners, for the smallest piece of sand which might be washed away from the mould would cause a waster casting. The reason for running the two castings separate was, if both castings were under one common runner, the one having any excess of runner area would consume the greater amount of metal and cause the other to be run too slowly, which would cause any sullage that might have been formed to become submerged, the presence of which, even if it was not in evidence upon the machined parts, would be sure to cause a porous part when the casting was under hydraulic test. As such castings were tested up to 1,000 lbs. per sq. in., it could be appreciated that the slightest flaw or a porous material would cause them to leak, with ultimate rejection as scrap.

Discussion.

MR. S. H. RUSSELL (Leicester), a past president of the Institute of British Foundrymen, said there was no doubt that the lecturer had made a clear and careful study of his subject; indeed, it was difficult to offer any criticism at all. It had been said in regard to a cast made with a hole in it that sometimes there was cracking and that this difficulty had been overcome by casting the metal with a square hole in it instead of a round one. With that he did not agree, because a round hole was, in his opinion, always the stronger. Perhaps there was another reason why cracking disappeared. With regard to the windows in the box and the taking of the centre core out while the casting was hot, it had occurred to him that the thin metal would be exposed to the air. He thought cracking occurred because core makers knew how wonderfully porous oil sand was, and, therefore, did not put in the quantity of ashes they would do if using loam cores. The core makers discovered that ashes and coke were unnecessary in oil sand and left them out, and the result was they had a solid sand block. They would very rarely get a cracked casting by using oil sand. With regard to the chill test, he had tried to do it and had failed. He could not read a fracture in a chilled test. One thing, they did not get a straight line. They could not tell where the chill finished and the line tended to zig-zag. He was glad to see so many Nottingham foundrymen present, and declared they would find the membership of the Institute was of immense value. He knew of no scientific association in which information to the benefit of the members was so freely given; in fact, he was convinced that many problems he had had to solve in his own foundry was not due to his experience alone but due to the experience of others in the Institute.

Standard Composition and Diverse Results.

MR. H. PEMBERTON (Derby) said Mr. Key's address had been of great value. With regard to the Diesel-engine cast and the mixture, he said he had never yet come across pig-iron that gave such a low percentage of silicon. He was rather interested in Mr. Key's remark that, although they might have a particular analysis of iron they would get different results according to the materials obtained. Although he was rather inclined to agree with Mr. Key, it put them in a difficult position with the metallurgist, because the metallurgists might say, "There you have an analysis and that should give you certain results." He had been deeply interested in the design of the moulding box for the cylinder block. It was an ingenious method of making a cover in the moulding box, whereby they could extract the core from the inside and allow of equal cooling to take place. It was a thing he had not seen in the whole of his experience.

Cinders in Oil-Sand Cores.

MR. E. STEVENSON (Nottingham), who paid high tribute to Mr. Key, referred to ashes in oil-sand cores, and said that personally he had found no necessity for putting them in. If they examined oil-sand cores under a microscope they would find the grains were balancing on edges and simply held together by a little volume of oil. He was particularly interested in the chill argument, but though it was only by experience and practice that they would, in time, be able to find what was the real depth of a chill. He was sorry Mr. Key had not gone more into the details of the moulding machines

Vote of Thanks.

MR. T. SPIERS (Leicester) proposed a vote of thanks to Mr. Key, and MR. A. E. PEARCE (Derby), in seconding, spoke with regard to a point raised by Mr. Pemberton in regard to the difference in pig-iron. He had said metallurgists told them they always obtained the same results. However, as a metallurgist himself, he did not agree. They never went on to a new grade of pig-iron unless they had 100 tons in for a trial.

Author's Reply.

MR. KEY, in reply, said he was glad if they had learned something, but regretted there was no criticism to which he could reply. With regard to the point raised by Mr. Russell as to the square and round hole in a cast, he said the reason they changed the hole from round to square was because it was found necessary and advantageous to do away with the round hole. It was not eliminated with the object of making the casting stronger; it was obvious that a round hole was always the stronger.

Ameliorating the Foundry Industry.

MR. MAKEMSON (General Secretary), who spoke with regard to the benefits to be derived by belonging to the Institute, asked, "What is the Institute?" He had met some people who thought it was at trades union, and others who thought it was an employers' federation. It was nothing of the kind. They had nothing to do with trade-union problems or matters that concerned an employers' federation. "Our job is different," he said. "Our work concerns only the foundry progress. It is our aim to improve the methods and processes for the people who are doing the job." It was common nowadays for men of various trades and professions to join an organisation that would help them to improve their daily work, and that was the reason the Institute was founded. It was only to be expected that the foundry industry should have its organisation like any other profession. Really it was an educational association for their own particular trade. Experience was, unfortunately, a very slow schoolmaster and it was also the most expensive, because a large number of mistakes were made before the final solution was discovered. However, by being associated in the Institute they were able to converse and exchange knowledge, with the result that many problems were solved much sooner than would otherwise be the case. They were also able to make fresh acquaintances with men engaged in other foundries who, perhaps, were doing similar work to themselves, and they could offer solutions as to how problems might be overcome.

A Recently-Introduced Aluminium Alloy.

(*Continued from page* 68.)

castings filled, in 99 cases out of 100, with no sign of defect in the boss. Again, a large radial aero-engine crankcase casting was cast at 730 deg. C. without any sign of small blowholes. He considered that the speckiness which occurred merely as the result of pouring temperature is governed by the sections of the casting and the rapidity with which the sand chills them.

The majority of castings in this material could safely be left in the moulds for a considerable period, and he had not found it necessary, even in the case of the most delicate castings, to break out sand cores until the castings were practically cold.

Heat Treatment.

In the majority of cases heat treatment was not necessary, but for particularly highly stressed parts the treatment necessary is to heat the casting to 175 deg. C., holding it there at least 16 hours, and quenching in water. All casting could be carried out safely in green-sand moulds. A mixture of 75 per cent. of common floor sand and 25 per cent. Mansfield was the best for moulding; heavy cores may be made in a mixture of 60 per cent. floor sand and 40 per cent. Charlton loam—his firm usually mixed a small quantity of wood sawdust with this; delicate or intricate cores may be made in sea sand with a mixture of some good core binder, mixed in proportions of 1 to 30.

Cast-on Test-Pieces Preferred.

With regard to test-pieces, he said that if he were a designer of highly stressed parts he would have the test-pieces integral with all patterns; they would be in position on the casting and of such a shape as to be under the same conditions in casting as the part of the casting that he desired to test. One could then select from any casting at random test-pieces which would give a good indication as to whether or not the casting were truly serviceable. He also expressed the view that, at any rate in the smaller foundries, there was not sufficient inspection of the virgin metals and ingot alloys, and that much of the trouble experienced in foundry work could be avoided thereby. An important test of an ingot was the examination of a micro-section. Another good test, especially for tracing occluded gas, was to cast samples of the material into sand moulds 6 in. in diameter and 1 in. thick, and then machine the material for inspection.

Microphotographs indicating incipient fusion were shown; in the case of duralumin this occurred at 540 deg. C., in "Y" alloy it occurred at 560 deg. C., and in R. R. 50 alloy it occurred at 580 deg. C. Thus, there is much greater working range and heat-treatment range in the R. R. 50 alloy than in the other two.

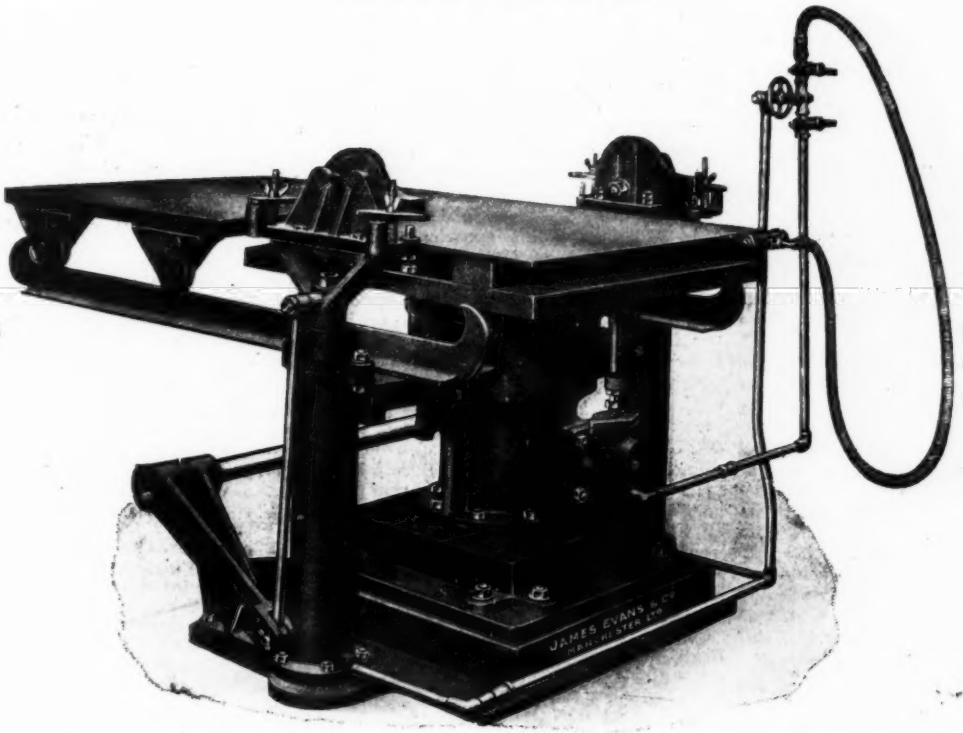
TYPE "C"

JAR RAM MOULDING MACHINE

with Turnover Pattern Plate.

For Pneumatic Power.

TWO MACHINES IN ONE.



UNSKILLED LABOUR ONLY REQUIRED.

The above machine illustrates a Jar Ram Machine with Turnover Pattern Plate which can also be used for Stripping Plate Work.

The machine has been designed to combine the two distinct features above mentioned, and is practically two machines in one, equally suitable for steel, iron, etc.

The machine as illustrated is arranged for work that requires turning over, such as steel moulding. And while the turnover arrangements are intended for general repetition work, by detaching the turnover plate from the trunnion brackets the machine can be used for stripping plate work by attaching the stripping plate to the trunnion brackets. Or, on the other hand, by removing the trunnion brackets as well, the table can be used for jolting general jobbing work.

A very important feature of the machine is the simplicity with which the intensity of the Jolt can be regulated when the operator has become accustomed to the use of the machine, which takes but an hour or so. The valves all being on the exterior of the machine are easily accessible, and there is an adjustable arrangement that will allow the jolt to be varied between 1½ in. to below ¼ in. This being done without disturbing any part of the machine.

The machine is supplied with Withdrawal Carriage, Vibrator, and Blow-off Nozzle complete. It is substantially constructed to stand heavy wear and tear, and requires a minimum amount of skill to operate.

Another important feature of the machine is in the arrangement of the hard wood anvil block for receiving the shock. The blocks being carried well down the machine in a specially designed annular chamber give considerable relief to the foundations. It also provides against the possibility of fracturing the jolting table. Pitch pine blocks are also inserted between the foundation plate and the machine bedplate to assist in the relief on the foundations, and these features considerably improve the working advantages of the machine.

IT IS ALSO ENTIRELY OF BRITISH DESIGN AND MANUFACTURE.

JAMES EVANS & CO. (M/c) LTD.

Britannia Works, BLACKFRIARS, MANCHESTER.

The Iron and Steel Trade.

HISTORY AND PROSPECTS.

MR. H. J. SKELTON, speaking at the second monthly luncheon of the London Iron and Steel Exchange, held in London on January 14, Mr. Watson Slack in the chair, referred to the advent of steel rails and recalled, as a result, the collapse of quite a number of iron concerns. Having mentioned these, he said that perhaps his hearers would not be unduly frightened when they heard that since 1913 no less than 59 firms in the puddled-iron trade had gone out of existence or had shut down. It was the steady progress of Bessemer acid steel that had affected these puddled-iron works when many changed over to steel.

In 1877 there had been quite a flutter in the steel trade because the Admiralty had resolved to build two steel ships; they had laid down the "Iris" and the "Mercury" at Pembroke Dockyard, these ships being built of Siemens acid steel made at the Landore Siemens steel-works near Swansea. He also recalled that in 1879 the Tay Bridge had collapsed. At the subsequent inquiry some fault was found with the engineering design, and it had been suggested that the wind bracing of the bridge was insufficient. It was also discovered, however, in the course of the inquiry, that the contractor had used holding-down bolts of common Cleveland iron instead of the Lowmoor iron that had been specified. The same firm of contractors had sent quantities of iron rails to South Australia, and they were found to be defective. They had deceived the inspecting engineer in this country before shipment, and from that time the Australian Government had not only adopted steel rails and had insisted upon the inspection of them in this country before shipment to Australia, but had also refused to pay for them until their arrival in the colony. That had been the practice very largely ever since.

Mr. Skelton emphasised how very much regular quality of material and fair dealing affected continuity of trade. As Britishers, he said, this was our principal asset in overseas markets, and we should discourage any attempt to lower the quality of goods in order to lower prices.

Constitution of Committee of Inquiry.

Referring to the Committee appointed by the late Government to inquire into the conditions of the iron and steel trade—whose inquiry was to be private—Mr. Skelton said he believed there was not one single member of that Committee with an intimate knowledge of the economics of the iron trade. It appeared, however, that the idea had occurred to somebody that perhaps the Committee should include someone who knew something about metals, and they had invited the Chairman of the Metal Exchange, but the Metal Exchange dealt with non-ferrous metals only. Many and confusing counsels had been offered to iron and steel-makers.

There were promises of protection, safeguarding, and Merchandise Marks Act Orders; there were denunciations of merchants who, with their exaggerated profits, were supposed to make things so difficult and to have prevented the payment of dividends such as the iron and steel-makers would have liked to have paid, but some manufacturers had found, in recent years, that these merchants' profits were more imaginary than real.

Steel-Making Capacity.

Under war-time conditions a productive capacity of about 8 million tons of steel was changed into a potential capacity of 12 million tons. These extensions were made without any possibility of being able to compete effectively under peace-time conditions, and they seemed to have been grumbling considerably because they could not continue the high prices necessary to maintain these hasty and improvised extensions, which had not justified expectations of employment under peace-time economic conditions. There were so many vested interests which obtruded themselves to prevent people facing facts. He saw at present a great unwillingness to do so. Even the Lord Privy Seal, who had to deal with the question of employment, would hesitate to tackle the problem of the cost of railway transport. He supposed every member of the House of Commons would admit that the railways of this country were over-capitalised. What action would one expect from a Member of Parliament when one told him that the average number of shareholders in a railway undertaking was 200,000, and that there were 750,000 men in the National Union of Railwaymen—and all these people had votes? Did even Mr. J. H. Thomas see the necessity, in view of Britain's economic position, of carrying an iron ore with 25 per cent. of metallic iron at half the price charged for iron ore containing 50 per cent. of metallic iron?

Placing Contracts Abroad.

As a result of his experiences he strongly urged all buyers of Continental steel to insist upon having an arbitration clause in their contracts, which clause should specify that arbitration should take place in the larger and more neutral atmosphere of London. It was well known that ten years had elapsed before a large merchanting firm in the City had obtained redress from the French authorities for some breach of contract, the sum involved being some £20,000, which had been recovered recently. Another case that had come before him was one in which an English merchanting firm had bought some better-class steel sheets, to be made by the Siemens process. The samples delivered were first-class, but the bulk, amounting to several hundreds of tons, had shown the erratic results which often attended certain makes of steel from the Thomas or Bessemer basic process. Chemical analyses made in London and in Brussels had shown the irregularities that were often found in Thomas steel. Whether the fault lay with the sheet roller or the suppliers of the sheet bars he did not know, but there was either carelessness or fraud. The various legal authorities and others in France had agreed that the English company had a good case, but there was a clause in the contract which provided that in the event of dispute recourse should be had to a French court at Rennes. The case might have dragged on for years, but the merchants had preferred to cut their few hundred pounds' loss and close the account with the French suppliers. It was not sufficient to stipulate in a contract that the material was to be inspected and agreed upon at the works. The Continental works made it increasingly difficult to inspect the materials, for they did not want too much supervision or control. Therefore, he recommended that any clause stipulating that differences should be settled in a Continental law court should be excised; the buyers should be able to dictate the terms.

"Middlemen" and their Functions.

These things indicated the losses which respectable merchant firms were at all times liable to have to meet, when acting between an untrustworthy supplier and a customer abroad who did not hesitate to make claims on account of the inferiority of goods, especially if the market had weakened. The rather foolish persons who talked glibly of "middlemen" had no experience of the iron and steel trade. The merchant performed a distinctly economic function; if he knew his business properly he was an expert, and, as an example of the expert knowledge required by them, he mentioned the great skill which was exercised by tinplate merchants in selection. In America, he continued, they had always known how to protect the distributing merchants; in Germany recently a schedule of prices had been fixed—there being one price for the consumer and another price (slightly lower) for the distributing merchant—and he did not think it would be denied that both America and Germany could give good examples in the way of organisation in sales. The path of safety was to buy goods through the medium of an expert broker or an experienced and responsible merchanting house.

Concluding, the speaker said: We were in for an era of rational control. The unregulated course of markets, with periodic bursts of frenzied competition, was already behind us. When we had settled down to the scrapping of old plant or lay-outs, some old ideas and many vested interests, we might look forward with calm, unprejudiced vision to our rise to greater heights and increasing influence for good in the world.

The German United Steel Works Corporation.

The report of the Vereinigte Stahlwerke A.G. for the first quarter of the current financial year (October-December, 1929) is a reflection of the situation of the coal, iron and steel industry in Germany during the quarter; it records a reduction in the output of both coal and pig-iron, but a slight increase in that of steel. Thus the production of coal declined from 7,413,940 tons in the September quarter to 7,350,730 tons in the December quarter; that of coke from 2,709,629 tons to 2,657,190 tons, and that of pig-iron from 1,680,436 tons to 1,657,442 tons, while the make of steel rose from 1,695,920 tons to 1,705,526 tons in the same two quarters. At the same time the number of people employed diminished from 176,716 to 173,852.

The value of the turnover with third parties declined from 402,499,160 mks. in the September quarter to 354,205,645 mks. in the December quarter, of which the inland sales accounted for 256,000,934 mks. and 217,259,412 mks. respectively, and the exports for 146,498,226 mks. and 136,946,233 mks. respectively in the two quarters.

The orders on hand of the iron and steel works and finishing branches on December 31, 1929, represented about 70 per cent. of the corresponding volume of orders on the monthly average in the financial year 1928-29.

Reports and Dividends.

Allen-Liversidge, Limited.—Interim dividend on the ordinary shares of 4 per cent. (actual), less tax.

Tredegar Iron & Coal Company, Limited.—No interim dividend will be paid in respect of the year to March 31 next.

Steel Industries of Great Britain, Limited.—Dividend at the rate of 6¼ per cent. per annum on the cumulative convertible preference shares in respect of the half-year to December 31 last.

New Companies.

Stevensons, Limited, Fylde Road, Preston.—Capital £5,000. Engineers, etc.

Guardian Metals, Limited, Grand Buildings, Trafalgar Square, W.C.—Capital £5,000. Directors: G. H. Buxton and J. H. Hicklin.

J. Gratrix & Company, Limited, Brieryfield Road, Preston.—Capital £3,000. Ironfounders, etc. Directors: L. H. Clarke and W. H. Holland.

Webb Conveyors, Limited, King William Street House, Arthur Street, London, E.C.4.—Capital £50,000 in £1 shares. Directors: Viscount Masereene and Ferrard, Lt.-Col. E. W. Spiers, C. Erlund, Lt.-Col. J. P. Hodge, Sir Peter Clutterbuck, L. S. Delapena and J. B. Webb.

Contracts Open.

Chatham, February 3.—Sewer ironwork, iron bars and other material for blacksmith's work, for the Town Council. The Borough Surveyor's Office, Town Hall, Chatham.

Johannesburg, February 13.—44 pairs of carriage wheels and axles, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 8,991.)

This is a page of the Foundry Data issued gratis by the B. A. Co., Ltd.

ALUMINIUM-COPPER ALLOYS

Aluminium Data Sheet **A127**

Copper forms with aluminium an important series of alloys which are chiefly used for casting purposes, but are also employed to some extent as sheet, rod and wire.

The tensile strength and elastic limit of the alloys increases with increasing content of copper, reaching a maximum with about 8% of copper. The increase in strength is, however, accompanied by a decrease in elongation, as indicated by the following figures, which were obtained on a series of machined chill cast bars of the British Standard form:

% Copper	Sp. Gr.	Commer. Elastic Limit Tons/sq. in.	Ultimate Strength Tons/sq. in.	% Elong. on 2"	Brinell Hardness	Izod ft. lbs.
3·5	2·75	3·7	10·2	18·0	54	7·5
6·0	2·80	6·2	11·5	10·0	60	4·1
9·0	2·84	8·3	12·4	6·0	72	3·5
12·0	2·94	9·7	12·6	2·3	89	1·7

It will be observed that the 12% copper alloy has a substantially lower elongation than lighter alloys without compensating advantages as regards strength. However, this particular alloy has a certain use owing to its greater hardness and its somewhat better machining and founding qualities, and also because it maintains its strength better at high tempera[tures]. It is used largely for the manufacture of piston[s].

The 8% copper alloy is the most commonly [used] for general castings and is sometimes designate[d] 'No. 12 Alloy'. It also corresponds very close[ly] the 3 L 11 alloy (see Data Sheet A121).

All the copper alloys are susceptible to heat [treat]ment (see Data Sheet B25), whether in the ca[st] rolled form. For example, a 6% alloy when i[n] chill cast form showed a tensile strength of 11 tons/sq. in. with 10% elongation, and after heat treatment reached 21 tons/sq. in. with 13% elongation.

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"WHEREVER great forces have to be exerted to overcome inertia the reduction of that inertia by the use of lighter materials must prove advantageous, not only in reducing the power consumed in setting the object in motion, but also in avoiding the heavy wear and its concomitant cost in lubrication or periodical replacement."

THE METALLURGIST (*supplement to* The ENGINEER) 27/12/29.

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Trade Talk.

THE CONSETT IRON COMPANY, LIMITED, are re-starting their No. 8 blast furnace.

MR. WILLIAM LLEWELLYN, aged 61, of Codnor, a roll-turner at the Butterley Company for 45 years, died last week.

REPRESENTATIVES OF THE thirty-eight or more trade unions in the engineering industry met in London yesterday to discuss a wage application to the employers.

TWO 12,300-TON TANKERS have been placed with Messrs. Palmer's Shipbuilding & Iron Company, Limited, of Jarrow-on-Tyne, by the Anglo-American Oil Company, Limited.

THE VULCAN FOUNDRY, LIMITED, Newton-le-Willows, have received a contract to supply the Central Argentine Railway with twenty locomotives, at the price of £150,000.

AN EXPERIMENTAL LIGHT-WEIGHT double-deck tramcar now running in Birmingham has been constructed practically of aluminium and aluminium alloy. The car is 4 tons lighter than the ordinary car.

OVER 600 EMPLOYEES have been added in the past month to the regular staff at the Cork works of Henry Ford & Son, Limited. There are now 5,378 persons working on the production of the Fordson tractor.

THE ADMIRALTY has placed an order with Messrs. J. Samuel White & Company, Limited, of Cowes, for propelling machinery for two sloops of the Royal Navy, which are being built at Chatham and Devonport.

THE DIRECTORS of the English Steel Corporation, Limited, have decided to close the Yorkshire Steel and Iron Works at Penistone, which the Corporation acquired from Messrs. Cammell, Laird & Company, Limited.

THE DIRECTORS of the Southern Railway Company have authorised the expenditure of about £4,300,000 on various new works for 1930, involving the construction of new locomotives and rolling stock, new steamships, new stations, and electrification extensions.

MESSRS. RICHARD GARRETT & SONS, LIMITED, have recently booked orders for nine standard rigid six-wheeled wagons, two rigid six-wheeled side-tipping wagons, nine rigid six-wheeled three-way tipping wagons, and two four-wheeled "Garrett" steam wagons.

IN THE LIST of calendars, diaries, etc., received, which appeared in our last issue, the address of Mr. R. A. Miles, the Manchester representative of the Stanton Ironworks Company, Limited, was erroneously given as 10, Deansgate, Manchester. This should have been 16, Deansgate.

LAST YEAR the total value of special steels exported from Sheffield to the United States was £251,000, an increase of £20,000 upon the total for 1928. There was also an export of a value of £49,000 in safety razors, blades, and blanks for the making of blades. The export of cutlery showed a decline of £16,000, to £73,000.

A CONTRACT, VALUED AT £100,000, for 10,000 tons of tram rails for the London County Council has been divided equally between Messrs. Dorman, Long & Company and the Cargo Fleet Iron & Steel Company. Contracts for railway chairs, valued at £50,000, for the L.M.S. Railway, have also been distributed amongst Tees-side firms.

MESSRS. MARKHAM & COMPANY, LIMITED, of Chesterfield, have received an order from the Randfontein Estates Gold Mining Company, Limited, of South Africa, for a pair of winding engines, having cylinders 38 in. by 72 in. stroke, with drop steam and Corliss exhaust valves. This is a repeat order, except that the first set was fitted with a pair of 40-in. cylinders.

THE BLYTHSWOOD SHIPBUILDING COMPANY, LIMITED, Scotstoun, have received a contract for a tanker of 11,250 tons deadweight from the P. L. Shipping Company, Incorporated, of New York. The vessel will be supplied with propelling machinery, consisting of Burmeister & Wain-type heavy oil engines of 3,000 b.h.p., to be built by Messrs. John G. Kincaid & Company, Limited, Greenock.

MESSRS. GIBBONS BROS., LIMITED, Dibdale Works, Dudley, Worcestershire, have entered into an agreement with Messrs. Wild-Barfield Electric Furnaces, Limited, of Elecfurn Works, North Road, Holloway, London, N.7, for the manufacture of large Wild-Barfield industrial electric furnaces. The range covered includes box-type heat-treatment furnaces, carburising furnaces with or without mechanical charging, rotary hearth furnaces, and continuous and conveyor furnaces.

MESSRS. ALEXANDER, STEPHENS & SONS, LIMITED, Linthouse, Glasgow, have launched the turbine-propelled passenger steamer "St. Patrick," built for the English Channel and Irish services of the Great Western Railway Company. The vessel is 290 ft. in length, and will have accommodation for 500 passengers. She is intended for the Weymouth Channel Islands daylight route, as auxiliary to the "St. Julien" and the "St. Helier." The propelling machinery consists of Parson's single-reduction geared turbines, working with steam at 230 lbs. The trial speed will be 20 knots.

AT OLD HILL, on January 13, at the Upper Stour Valley Main Sewerage Board meeting, the engineer reported a further movement of the main sewer near Furnace Hill, Halesowen, owing to mining operations. The engineer also reported that the old pumps installed at the Tilford pumping station 31 years ago were badly worn. With the exception of the framework, the whole of the machinery needed replacing, and he did not think that heavy expenditure on the repairs would be justified. The Board directed the engineer to ascertain the costs of both gas and electrically-driven pumps.

WITH THE PUBLICATION of their seventh regional scheme for the electrical development of the country, the Electricity Commissioners have now issued plans covering 94 per cent. of the area of England and Wales and 98 per cent. of the population. The latest scheme is for South-West England and South Wales, and it deals with an area of about 17,234 square miles. The cost of the scheme to the Central Electricity Board for the erection of the transmission system is estimated at £4,163,484. In addition, there will be expenditure by existing electrical undertakers of about £1,934,360 on extensions of some of the existing stations. At present there are 165 authorised electrical undertakers in the area, owning 107 public generating stations. Under the scheme now outlined the following six selected stations will be operated by the Board:—Cardiff Corporation, Hayle Cornwall Power Company, Newport Corporation, Bristol Corporation, Southampton Corporation, Upper Boat (South Wales Power Distribution Company), a new station in the neighbourhood of Southampton, and a new station in South Wales. As a transitional measure a further eleven stations will be worked for a few years. Broadly speaking, it is contemplated that two of the selected stations, Portishead (Bristol) and Upper Boat, will supply the base load. The remainder will be used for the peak load.

Obituary.

WE REGRET to announce the death of Mr. Wilfrid Lewis, president of the Tabor Manufacturing Company, 6225, Tacony Street, Philadelphia, Pa., U.S.A., who died on board ship off Ceylon on December 19 last year. He was a pioneer of the moulding-machine industry, and was well established by the early 'nineties. He joined the American Foundrymen's Association on its creation in 1896, and has contributed useful practical Papers to their Proceedings.

THE DEATH occurred, on January 12, at his residence in Bonnybridge, of Mr. George Mitchell, of Bonnymuir Foundry, in his 85th year. Mr. Mitchell served his apprenticeship in the Carron Works, and about 60 years ago he entered the employ of Messrs. Smith & Wellstood as a moulder. Forty years ago he took over the business of Bonnymuir Foundry, which, under his management, proved very successful until about three years ago, when he retired owing to failing health.

PROFESSOR AUGUSTE RATEAU, a French engineer who played a great part in the development of turbine machinery, died in Paris on January 13, in his 67th year. Professor Rateau was born in 1863 in Royan, at the mouth of the Gironde, and was educated at the Grammar School of Cognacq, and at the Ecole Polytechnique and the Ecole des Mines in Paris. He founded his company, the Société Rateau, in 1903. Originally it was intended chiefly to build centrifugal pumps, but gradually took up the manufacture of steam turbines, and has become to-day an important manufacturing concern, with four works in France and Belgium, employing over 3,000 hands, with many branches outside France. One branch of this firm was opened two years ago in London. Professor Rateau delivered many lectures in this country, and published several Papers. He was the second engineer to become a member of the French Academy of Science, and was Inspector-General of Mines.

Personal.

MR. CYRIL EDWARD LLOYD has joined the board of Associated Electrical Industries, Limited.

LORD MELCHETT, chairman of Imperial Chemical Industries, Limited, sailed for South Africa on Friday, January 10.

SIR HUGH BELL, BT., has been elected chairman of the Cleveland Mine-Owners' Association for the 25th successive year.

MR. JOHN BELLISS, of Messrs. Belliss & Morcom, Limited, Birmingham, has returned from a three-months' visit to Canada.

MR. G. G. L. PREECE, until recently manager in the Manchester district for Messrs. Bruce, Peebles & Company, Limited, Edinburgh, has been appointed to the position of sales manager for England and Wales.

MR. G. P. WEST, general manager of the works of Messrs. David Colville & Sons, Limited, has resigned from that position for family and health reasons. He has consented, however, to remain a director of the company.

AT THE WORKS of Messrs. Chance Bros. & Company, Limited, Firhill, Glasgow, Mr. Lindsay Foster, managing director, presented the company's long-service medal to Mr. John Trayner, the works manager, who has completed 50 years' service in the works.

MR. THOMAS HARVEY, managing director of Messrs. John Williams & Company, Limited, Excelsior Works, Wishaw, has accepted the invitation of the directors of the Motherwell Iron & Steel Company, Limited, to join the board as managing director. He will enter upon his new duties at the beginning of February.

MR. A. PARKER HAGUE has been appointed general manager of the Swansea works of the Mond Nickel Company, Limited. Mr. Hague has been associated with Messrs. Cammell, Laird & Company, Limited, Sheffield, for 25 years, and for the past 15 years has been manager of the armour-plate department. In addition, he has been chief metallurgist for the past ten years.

After 33 years as master of works in Messrs. Babcock & Wilcox, Limited, Moorpark, Renfrew, Mr. Andrew Leckie has retired, and to mark the occasion he has been presented with a display cabinet from his fellow-workers, including foremen, staff and departmental employees. Mr. Leckie has been in the employ of the firm 41 years.

MR. JOHN SMITH, of Dalry, Ayrshire, to whom the Geological Society of London has just awarded the Murchison Geological Memorial in recognition of his contributions to geology and palæontology of the West of Scotland, was for 19 years works manager of Messrs. William Baird & Company, Limited's, ironworks at Kilwinning. It is claimed that Mr. Smith has contributed more Papers to the Geological Society of Glasgow than any other member. He is in his 85th year.

MR. JAMES SMITH, of South Shields, has been elected president of the National Ironfounding Employers' Federation. Mr. Smith is a director of Smith & Company (South Shields), Limited, Holborn Foundry, South Shields; he has presided over the North of England Ironfounders' Association and the Newcastle Section of the Institute of British Foundrymen. It is interesting to note that, as an apprentice, Mr. Smith moulded the coat of arms castings on Hammersmith Bridge.

MR. A. VINCENT KEMP, consulting engineer, a former director of the Wellman Smith Owen Engineering Corporation, Limited, has become associated with Gas Chambers & Coke Ovens, Limited, Artillery House, Westminster, S.W.1, who are the sole licencees in the British Empire for the Collin coke-oven plant and builders of the C.O.L. intermittent vertical chamber ovens. It is understood that Mr. Kemp will still continue his consulting practice in connection with furnace and heat-treatment equipment for all metallurgical purposes.

MR. W. MAAS GEESTERANUS, of Amsterdam, has been elected chairman of the Dutch Foundry Technical Association, in succession to Mr. H. van Aarst, who died in September last, and Professor D. Dresden has been elected a member of the Management Board. Mr. van Aarst's position as chairman of "Covny," the Dutch Foundry Owners' Association, has been filled by the election of Mr. S. H. Stoffel, and Mr. G. Dikkers has been elected a member of the board of this Association in succession to Mr. H. Kuyk, who has recently resigned. Both Professor Dresden and Mr. Stoffel have taken part in many international meetings of foundrymen, and are well known to many foundrymen in this country.

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A QUESTION

Do British Steelfounders realise that every pound spent in British Sands tends to come back to them because it is spent in this country, but that every pound spent in Foreign Sands is not only lost to them but by affecting the rate of exchange against this country, tends to make food imports more costly?

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Our new Sand Milling and Mixing plants being now completed, we having equipped ourselves with Mechanical Excavators, Disintegrators, Loaders and such plant as will compare with any in the world; owning our own land, quarries and railway trucks, in a word, having equipped ourselves to the best of our knowledge and ability and in a manner we feel to be worthy of the reputation of

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Business this week in the Cleveland iron market has again been almost entirely confined to the satisfaction of consumers' more immediate requirements, transactions on forward account now being the exception, as no advantage is to be obtained by buying in advance with quotations at current fixed levels. The probability of an upward move in Midlands pig-iron prices, which is freely hinted at, may, however, provide the necessary impulse before the end of the month. In any event, the Cleveland ironmasters have not a big surplus for disposal. Only a limited number of the blast furnaces now in operation is confined to the production of foundry pig, restriction of output being at present the settled policy of the ironmasters, and, whilst there are furnaces ready for relighting, this step is deferred until the position improves. The export trade is still very quiet, but a little more business has been done this month with Scottish consumers. Prices are as follow:—No. 1 Cleveland foundry iron, 75s.: No. 3 G.M.B., 72s. 6d.: No. 4 foundry, 71s. 6d.; No. 4 forge, 71s. per ton.

In striking contrast to the almost stationary condition of the Tees-side foundry pig industry, the hematite section on the North-East Coast continues increasingly active, as convincingly evidenced by the Consett Iron Company, Limited, having just relighted their No. 8 blast furnace. This is claimed to be the biggest furnace in the North of England. It has an output of well over 2,000 tons per week, and will be engaged on the production of hematite. Makers generally have some good forward contracts, but holiday accumulations have not yet been cleared from the works. Prices for prompt delivery are consequently easy, quotations for mixed numbers for January delivery ruling at 78s. per ton, with 80s. for beyond the end of the month. On the North-West Coast, Bessemer mixed numbers are quoted at 78s. per ton at works.

LANCASHIRE.—Conditions in the local markets for foundry pig continue fairly satisfactory, sellers reporting that deliveries to consumers in this area now are on a higher scale than at any time since the general strike of 1926. Values all round are quite strong, offers of Derbyshire and Staffordshire descriptions being at 77s. per ton, delivered equal Manchester. There is only a very moderate demand for Scottish foundry pig, but quotations are well held at around 95s. per ton, delivered.

THE MIDLANDS.—Reports from the Black Country area of late have indicated a temporary decline in the demand for foundry pig, due probably to the unsettled conditions usually experienced at this period, and which, it is confidently expected, will improve as the quarter advances. In the meantime, most, if not all, brands of pig-iron are now quoted at the minimum zone rates, which are 75s. for Northants No. 3 and 78s. 6d. for North Staffordshire and Derbyshire No. 3, with Scottish qualities at 96s. 6d. to 97s. 6d. delivered local stations.

SCOTLAND.—Although the works have now all resumed, it cannot be said that there is any rush of business, and altogether the position seems to be rather restrained. The price remains unchanged at 78s. f.o.t. furnaces for No. 3 Scotch foundry iron, with a minimum of 2s. 6d. per ton extra for No. 1.

Finished Iron.

No change in the price of Staffordshire marked bars has been made, although the demand for this grade of iron continues at a satisfactory rate. The current figure is £12 10s. at works. There has also been a little improvement in the demand for cable iron, but there is little satisfaction in the present position affecting crown and the cheaper qualities of bar iron. The former are quoted at prices varying from £10 to £10 10s., and nut and bolt iron is at from £9 2s. 6d. to £9 7s. 6d. There cannot be any improvement in the rate of consumption of bolt iron from local works whilst foreign bars are imported at such low rates. At the present moment the imported product is quoted at nearly £3 per ton below the local figures.

Steel.

At Sheffield reports of trade conditions indicate little interest in market movements, with a further heavy reduction of the output of open-hearth steel in this area. The production of special steels, on the contrary, is expanding, and manufacturers of these have plenty of orders in hand to keep them busy for many weeks. Alloy steels are also a very good feature, but in these Continental competition is developing. British steelworks have, however, still a fair amount of work in hand, but are working off contracts more quickly than new business is coming forward. Perhaps the exception to this are those works producing shipbuilding material, specifications for which, as well as new orders, are reaching them in fair volume. In the tinplate market very little business is passing. The tone, however, continues to be good and prices are firm.

Scrap.

Movements in markets for foundry scrap metals are, at the moment, without special significance, with business generally quiet and limited in extent. On the North-East Coast, heavy cast-iron, ordinary quality, is only saleable in very small parcels at 62s. 6d. per ton, and 66s. 6d. is asked for good machinery quality. In the Midlands, the prices recently reported for heavy cast-iron scrap have been maintained, and quotations are firm. Heavy machinery cast-iron scrap realises 70s. per ton delivered, and 65s. per ton for ordinary heavy metal and 60s. per ton for light cast iron is offered. In Scotland, the cast-iron scrap market has not improved, and machinery quality is still quiet at around 70s.; ordinary heavy cast iron, suitable for foundries, is 63s. 6d. to 65s., old cast-iron railway chairs are 67s., and for light cast iron 58s. 6d. to 60s. is quoted. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Although closing last week at slightly lower levels than recently recorded, values of warrant copper remain remarkably steady, and from present appearances seem likely to maintain a similar position for some time to come. Moreover, there has been an improvement in export sales in the past week, and, as temporarily the demand appears satisfactory, consumers will have to become resigned to the prospect as outlined above.

Closing quotations are :—

Cash.—Thursday, £70 15s. to £70 17s. 6d.; Friday, £71 2s. 6d. to £71 5s.; Monday, £72 2s. 6d. to £72 5s.; Tuesday, £71 17s. 6d. to £72; Wednesday, £71 17s. 6d. to £72 5s.

Three Months.—Thursday, £68 17s. 6d. to £69; Friday, £68 12s. 6d. to £68 15s.; Monday, £68 10s. to £68 12s. 6d.; Tuesday, £68 12s. 6d. to £68 15s.; Wednesday, £68 10s. to £68 15s.

Tin.—The position as regards standard tin continues somewhat indefinite, prices fluctuating with some irregularity, influenced doubtless by the latest reports of the progress of regulating output. So far these have been fairly satisfactory, an announcement recently issued indicating that 54 dredges throughout Malaya had ceased working on Sundays, while fifty gravel pumps in Perak have closed down entirely. The example is likely to be followed by others, but at present it has had no great effect on the market.

Official closing prices :—

Cash.—Thursday, £176 5s. to £176 7s. 6d.; Friday, £174 2s. 6d. to £174 5s.; Monday, £173 15s. to £174; Tuesday, £172 5s. to £172 7s. 6d.; Wednesday, £170 17s. 6d. to £171.

Three Months. — Thursday, £179 10s. to £179 12s. 6d.; Friday, £177 5s. to £177 7s. 6d.; Monday, £176 15s. to £177; Tuesday, £175 5s. to £175 10s.; Wednesday, £174 to £174 5s.

Spelter.—The past week has produced little of interest in the spelter market. The demand from consumers is very poor, and consequently the market is irregular and inclined to be depressed. While fluctuations have been confined within narrow limits, prices have shown a tendency to decline.

Daily quotations are :—

Ordinary. — Thursday, £19 7s. 6d.; Friday, £19 7s. 6d.; Monday, £19 8s. 9d.; Tuesday, £19 12s. 6d.; Wednesday, £19 13s. 9d.

Lead.—The immediate outlook of the market for soft foreign pig is unchanged. The market has been steady, and there have been few alterations in prices. There is a tendency for consumers to be cautious, and the demand is consequently rather quiet.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £21 12s. 6d.; Friday, £21 12s. 6d.; Monday, £21 12s. 6d.; Tuesday, £21 12s. 6d.; Wednesday, £21 11s. 3d.

Foundrymen to Tour French Works.

At a meeting of the London Section of the Institute of British Foundrymen, held at the Engineers' Club last Thursday, it was decided to organise a visit to some representative French foundries. The party will leave London on March 23 and return on March 28. The cost will be in the neighbourhood of £10 to £15. Members of the industry desirous of joining the party should communicate with Mr. H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

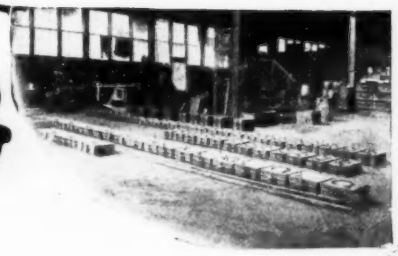
TEAM BY-PRODUCT COKE CO., LTD.
DUNSTON-on-TYNE
"TEAM" PATENT COKE
SPECIAL FOUNDRY QUALITY

FOR PRICE AND PARTICULARS APPLY TO:—
ALEXANDER LEITH & CO.,
25, COLLINGWOOD STREET,
NEWCASTLE-ON-TYNE.

TYPICAL ANALYSIS (if necessary guaranteed).

ASH	not exceeding	8%
SULPHUR	,, ,,	0·8%
VOLATILE	,, ,,	1 %
MOISTURE	under	1·50%

STERLING



ROLLED STEEL

Moulding Boxes

FOR THE MODERN FOUNDRY

Lightness and ease of handling, robust construction, accuracy and durability are the paramount essentials of the modern moulding box.

These qualities are solidly built into all STERLING ROLLED STEEL MOULDING BOXES.

They are made to suit your exact requirements, drilled to suit your existing pattern plates, and fitted with bars when required to conform to your patterns.

Many of the largest and most up-to-date foundries in this Country and Abroad are completely equipped with STERLING BOXES.

WRITE FOR CATALOGUE No. 37.

STERLING FOUNDRY SPECIALTIES LTD.

London Office:
13, VICTORIA STREET, S.W.1.

BEDFORD

Telephone: 3345 BEDFORD.
Telegrams: "STERFLASK, BEDFORD."
Code: WESTERN UNION.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	7	17	6
Three months	68	10	0
Electrolytic	83	5	0
Tough	76	0	0
Best selected	76	10	0
Sheets	110	0	0
India	90	10	0
Wire bars	84	0	0
Do. Jan.	84	0	0
Do. Feb.	84	0	0
Ingot bars	84	0	0
H.C. wire rods	86	2	6
Off. av. cash, December	68	7	3¾
Do., 3 mths., December	67	15	10½
Do., Sttlmnt., December	68	7	3
Do., Electro, December	83	3	6¾
Do., B.S., December	75	16	4½
Do., wire bars, December	83	15	9
Aver. spot price, copper, Dec.	68	7	3¾

Solid drawn tubes .. 15d.
Brazed tubes .. 15d.
Wire .. 11½d.

BRASS.

Solid drawn tubes .. 12¾d.
Brazed tubes .. 14¾d.
Rods, drawn .. 12¾d.
Rods, extd. or rlld. .. 7¼d.
Sheets to 10 w.g. .. 11¼d.
Wire .. 10¾d.
Rolled metal .. 10¼d.
Yellow metal rods .. 7¼d.
Do. 4 × 4 Squares .. 8d.
Do. 4 × 3 Sheets .. 8¼d.

TIN.

	£	s.	d.
Standard cash	170	17	6
Three months	174	0	0
English	171	15	0
Bars	175	5	0
Straits	174	0	0
Australian	173	5	0
Eastern	178	0	0
Banca	180	5	0
Off. av. cash, December	179	10	2½
Do., 3 mths, December	182	14	0
Do., Sttlmt., December	179	9	7½
Aver. spot, December	179	10	2½

SPELTER.

	£	s.	d.
Ordinary	19	13	9
Remelted	18	5	0
Hard	16	7	6
Electro 99.9	22	0	0
English	20	0	0
India	18	0	0
Zinc dust (Nom.)	30	0	0
Zinc ashes	6	0	0
Off. aver., December	20	7	5½
Aver., spot, December	20	1	3¼

LEAD.

	£	s.	d.
Soft foreign ppt.	21	11	3
English	23	0	0
Off. average, December	21	9	6¾
Average spot, December	21	9	5¼

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	30	0	0
Do. V.M. ex-whf.	27	15	0
Rods	34	0	0
Boiler plates	26	10	0
Battery plates	27	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	46	10	0
Chinese	30	10	0
Crude	18	10	0

QUICKSILVER.

Quicksilver .. 23 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	11	10	0
75%	19	0	0

Ferro-vanadium—
35/50% .. .. 12/9 lb. Va.
Ferro-molybdenum—
70/75% c. free .. 4/2 lb. Mo.
Ferro-titanium—
23/25% carbonless .. 9d. lb.
Ferro-phosphorus, 20/25% .. £16 0 0
Ferro-tungsten—
80/85%, c. fr. .. .. 3/1½ lb.
Tungsten metal powder—
98/99% .. .. .. 3/4½ lb.
Ferro-chrome—
2/4% car. £30 10 0
4/6% car. £23 2 6
6/8% car. £22 10 0
8/10% car. £22 0 0
Ferro-chrome—
Max. 2% car. £33 12 6
Max. 1% car. £39 0 0
Max. 0.70% car. £41 10 0
70% carbonless .. .. 11d. lb.
Nickel—99% cubes, or pellets £175 0 0
Ferro-cobalt .. .. .. 9/6 lb.
Aluminium 98/99% £95 0 0
Metallic chromium—
96/98% .. .. .. 2/7 lb.
Ferro-manganese (net)—
76/80% loose £12 10 0
76/80% packed £13 10 0
76/80%, export £12 15 0
Metallic manganese—
94/96%, carbonless .. 1/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten £0 2 0
Finished bars, 18% tungsten £0 2 9
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares, 3 in. and over .. .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. .. 3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in... 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. .. .. 3d. lb.
Do., under ½ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. .. 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				3	7	6
Bundled steel and shrngs.	3	2	6 to	3	5	0
Mixed iron and steel	3	2	6 to	3	3	6
Heavy cast iron	2	17	6 to	2	18	6
Good machinery for foundries				3	2	6
Cleveland—						
Heavy steel				3	3	6
Steel turnings				2	16	6
Cast-iron borings				2	13	0
Heavy forge				3	15	0
W.I. piling scrap				3	10	0
Cast-iron scrap	3	2	6 to	3	6	6
Midlands—						
Ord. cast-iron scrap				3	5	0
Heavy wrought				3	17	6
Steel turnings	2	5	0 to	2	7	6
Scotland—						
Heavy steel				3	10	0
Cast-iron borings				2	11	6
Wrought-iron piling				3	18	6
Heavy machinery				3	10	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	61	0	0
Brass	43	0	0
Lead (less usual draft)	19	0	0
Tea lead	15	0	0
Zinc	13	0	0
New aluminium cuttings	65	0	0
Braziery copper	57	0	0
Gunmetal	54	0	0
Hollow pewter	132	0	0
Shaped black pewter	98	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—

Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	78/6
Hematite M/Nos.	78/

N.W. Coast—

Hem. M/Nos. d/d Glas.	86/6
,, d/d Birm.	93/6

Midlands—

Staffs. common*	—
,, No. 4 forge*	74/6
,, No. 3 fdry.*	78/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—

*d/d Black Country dist.

Scotland—

Foundry No. 1	80/6
,, No. 3	78/-
Hem. M/Nos.	81/-

Sheffield (d/d district)—

Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge.	73/-
,, fdry No. 3	77/-
E.C. hematite	89/-
W.C. hematite	91/6

Lincs. (at furnaces)—

Forge No. 4	—
Foundry No. 3	—
Basic	—

Lancashire (d/d eq. Man.)—

Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.				10	15	0
Nut and bolt iron	9	2	6 to	9	7	6
Hoops				11	0	0
Marked bars (Staffs) f.o t.				12	10	0
Gas strip				11	0	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates	8	15	0 to	8	17	6
Boiler plts.	9	17	6 to	10	10	0
Chequer plts.				10	12	6
Angles				8	7	6
Tees				9	7	6
Joists				8	10	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)				8	2	6
				and upwards		
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs)				9	15	0
Black sheets, 24 g.	9	15	0 to	9	17	6
Galv.cor.shts., 24g.	12	5	0 to	12	10	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	6	2	6 to	6	12	6
Billets, hard	7	10	0 to	8	0	0
Sheet bars	5	17	6 to	6	5	0
Tin bars	5	17	6 to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.76
No. 2 foundry, Valley	18 50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y, at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents
Iron bars, Phila.	2.12
Steel bars	1.90
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.75
Sheets, galv., No. 24	3.40
Sheets, blue an'l'd, No. 13	2.25
Wire nails	2.40
Plain wire	2.40
Barbed wire, galv.	3.05
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	32/6 to 35/-
,, furnace	30/0 to 32/6
Durham and Northumberland—	
,, foundry	18/-
,, furnace	20/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	18/9
,,	28×20 ,,	37/6
,,	20×10 ,,	27/-
,,	18¾×14 ,,	19/6
C.W.	20×14 ,,	16/-
,,	28×20 ,,	34/6
,,	20×10 ,,	23/1½
,,	18¾×14 ,,	1?/9
Terneplates	28×20	32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water	61½%	42½%
Steam	57½%	37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Jan. 16	..	70	15	0	dec.	25/–
„ 17	..	71	2	6	inc.	7/6
„ 20	..	72	2	6	„	20/–
„ 21	..	71	17	6	dec.	5/–
„ 22	..	71	17	6	No	change

Electrolytic Copper.

		£	s.	d.		
Jan. 16	..	83	5	0	No	change
„ 17	..	83	5	0	„	„
„ 20	..	83	5	0	„	„
„ 21	..	83	5	0	„	„
„ 22	..	83	5	0	„	„

Standard Tin (cash).

		£	s.	d.		
Jan. 16	..	176	5	0	inc.	27/6
„ 17	..	174	2	6	dec.	42/6
„ 20	..	173	15	0	„	7/6
„ 21	..	172	5	0	„	30/–
„ 22	..	170	17	6	„	27/6

Tin (English ingots).

		£	s.	d.				
Jan. 16	..	177	5	0	inc.	25/–	Jan. 16	..
„ 17	..	175	0	0	dec.	45/–	„ 17	..
„ 20	..	174	15	0	„	5/–	„ 20	..
„ 21	..	173	5	0	„	30/–	„ 21	..
„ 22	..	171	15	0	„	30/–	„ 22	..

Zinc Sheets (English).

		£	s.	d.				
Jan. 16	..	30	0	0	No	change	Jan. 16	..
„ 17	..	30	0	0	„	„	„ 17	..
„ 20	..	30	0	0	„	„	„ 20	..
„ 21	..	30	0	0	„	„	„ 21	..
„ 22	..	30	0	0	„	„	„ 22	..

Spelter (ordinary).

		£	s.	d.		
Jan. 16	..	19	7	6	inc.	2/6
„ 17	..	19	7	6	No	change
„ 20	..	19	8	9	inc.	1/3
„ 21	..	19	12	6	„	3/9
„ 22	..	19	13	9	„	1/3

Lead (English).

		£	s.	d.		
Jan. 16	..	23	0	0	No	change
„ 17	..	23	0	0	„	„
„ 20	..	23	0	0	„	„
„ 21	..	23	0	0	„	„
„ 22	..	23	0	0	„	„

BLAST-FURNACE STATISTICS.

Furnaces in Blast at the close of each Quarter making Pig-iron Specified.

Quarter ended.	Hematite.	Forge and foundry.	Basic.	Ferro-manganese.	Total in blast.
1914					
March	98	146	47	11	300
June	90	143	45	12	290
September	94	133	41	15	286
December	100	136	46	12	294
1915					
March	102	130	52 2/3	10	294
June	103	126 1/3	54 2/3	10	294
September	105	117 1/3	52 2/3	11	287
December	108	111 1/3	50 2/3	15	284
1916					
March	116	106 1/3	50 2/3	12	285
June	120	106	54	13	293
September	124	107	58	13	302
December	126	110	57	18	311
1917					
March	131	111	62	16	320
June	129	116	70	15	324
September	123	102	78	19	322
December	118	99	85	13	315
1918					
March	117	102	92	15	326
June	120	108	86	16	330
September	120	104	83	14	321
December	113	108	72	15	308
1919					
March	98	109	69	13	289
June	97	107	78	7	289
September	66	99	53	5	223
December	77	113	62	8	260
1920					
March	92	108	72	10	282
June	97	119	68	12	296
September	93	122	73	12	300
December	77	125	59	13	274
1921					
March	36	70	10	3	119
June	—	1	—	—	1
September	17	41	10	—	68
December	22	41	15	3	81

Quarter ended.	Hematite.	Forge and Foundry.	Basic.	Ferro-manganese.	Total in blast.
1922					
March	31	46	23	7	107
June	25	55	28	9	117
September	27	74	27	10	138
December	46	83 1/3	30 2/3	10	170
1923					
March	52	93	45	10	200
June	62	103	45	13	223
September	38	98	42	11	189
December	50	99	49	9	207
1924					
March	45	94 2/3	51 1/3	10	201
June	45	91	46	8	190
September	44	85	38	5	172
December	42	87	31	7	167
1925					
March	40	84	36	9	169
June	31	76	32	9	148
September	28	67	30	5	130
December	38	74	32	4	148
1926					
March	39	79	33	4	155
June	3	5	4	2	14
September	1	4	—	—	5
December	24	33	20	2	79
1927					
March	50	86	39	7	182
June	46	86	36	10	178
September	41	78	36	7	162
December	38	72	31	6	147
1928					
March	35	70	35	6	146
June	35	65	39	3	142
September	34	55	39	6	134
December	34	53	42	6	135
1929					
March	40	56	44	5	145
June	44	62	52	7	165
September	48	62	52	7	169
December	44	63	43	6	156

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG

IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

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